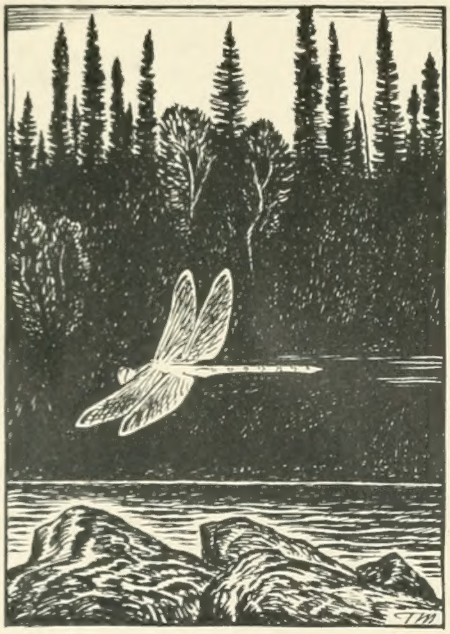

ZOOLOGISKA BIDRAG
FRÅN UPPSALA

(ZOOLOGISCHE BEITRÄGE AUS UPPSALA)

SUPPL.-BD. I

UTGIFNA AF

A. WIRÉN

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STUDIES
ON MARINE OSTRACODS

PART I

(CYPRIDINIDS, HALOCYPRIDS AND POLYCOPIDS)

BY

TAGE SKOGSBERG

TILL BANKDIREKTÖREN

H. MANNHEIMER

GÖTEBORG

FRAN FÖRFATTAREN

PREFACE.

The present treatise is based for the most part on studies carried out by me at the Zoological Institution of the University of Upsala on material belonging to the Swedish State Museum (Riksmuseum), Stockholm. For the purpose of carrying out verificatory investigations smaller collections have also been furnished by the Zoological Museum of the University of Upsala, the Christiania Zoological Museum, the Copenhagen Zoological Museum and by Professors G. W. MÜLLER, Greifswald and G. S. BRADY, Sheffield. In addition the Ostracod material brought home by the „Michael Sars North Atlantic Deep Sea Expedition". 1910 has been kindly entrusted to me for examination. — In order to study the oecology of the marine Ostracods and to collect material for this group of animals I have spent some summer months (assisted partly by grants from the Swedish Royal Academy of Science) at the west coast of Sweden (the Zoological Marine Station at Kristineberg) and from December 1915 till June 1916 (with a grant from the C. F. LILJEWALCH's travelling scholarship fund) at the Labotatoire Russe de Zoologie at Villefranche-sur-Mer and the Musée Océanographique de Monaco.

Among the Ostracod collections in the Swedish State Museum I found the original material of P. T. CLEVE's work of 1900 (a part of which had been already published by C. W. S. AURIVILLIUS in 1899). On re-examining this material I verified that *Conchoecia bispinosa*, *C. borealis*, *C. elegans* and *Microconchoecia Clausii* (= *Conchoecia curta* J. LUBBOCK) were correctly determined. On the other hand *Paraconchoecia oblonga* was incorrectly determined: the specimens on which this statement was based turned out to belong to *Euconchoecia Chierchiae* G. W. MÜLLER. See these species below. There was only a single specimen of *Conchoecetta* (= *Conchoecia*) *acuminata*; this was a male which was not yet mature (presumably belonging to the oldest larval stage). The length of this specimen was 2.1 mm.; the number of furcal claws seven. As far as could be seen the correctness of its determination was fairly certain.

In the collections of this museum there is also a part of the original material of *Conchoecia borealis*, *C. elegans* and *C. obtusata* in P. T. CLEVE's work of 1903 (= P. T. CLEVE and O. PETTERSSON, 1903). On re-examining this material I found that the determinations were correct.

In the collections of the Zoological Museum of the University of Upsala I found the original material of *Philomedes globosus* and *Cypridina Reynaudii*

W. LILLJEBORG, 1876. The correctness of the determination of the former species was verified. For the result of my re-examination of the latter form see the remark on the sub-genus *Cypridina* below.

The collection sent to me from the Zoological Museum of Christiania included the following species: *Cypridina (Vargula) norvegica* W. BAIRD, *C. (Vargula) megalops* G. O. SARS, *Philomedes Lilljeborgi* G. O. SARS, *Asterope norvegica* G. O. SARS, *A. abyssicola* G. O. SARS, *Conchoecia elegans* G. O. SARS and *C. borealis* G. O. SARS, all of which were determined by Professor SARS himself. For the results of my re-examination of this material see the respective species below. (On the same occasion as this collection was sent to me Professor SARS informed me that the original material of his work of 1887 — which I asked permission to investigate — had unfortunately been completely lost.)

From the Copenhagen Zoological Museum I obtained a portion of the material on which G. S. BRADY based his treatise of 1902 a. The following marine species were found in this collection (the names are those used in G. S. BRADY's treatise): *Asterope oculata*, *A. lichenoides*, *Cyclasterope fascigera*, *C. brevis*, *C. similis*, *Cypridina foveolata*, *C. insolita*, *Pyrocypris americana*, *P. Chierchiae*, *Cypridinodes favus*, *Codonocera cruenta*, *Conchoecia spinirostris*, *C. striata* and *Euconchoecia Chierchiae*. Of these species *Asterope lichenoides*, *Cyclasterope brevis*, *Cypridina foveolata* (according to G. S. BRADY's label — *Cypridina monopia* CLAUS) and *Codonocera cruenta* were represented by an empty shell and *Cyclasterope similis*, *Cypridina insolita* and *Cypridinodes favus* only by one valve. Because of this I thought it best not to deal with these forms at any length in this work. *Asterope oculata* and *Cyclasterope fascigera* are re-described by me below. *Conchoecia spinirostris* (from lat. 26° N. and long. 29° W.) and *Euconchoecia Chierchiae* were correctly determined; see these species below.* For the result of my re-examination of *Pyrocypris Chierchiae* see the remarks on the sub-genus *Cypridina* below. For the same reasons as are given at the place mentioned it did not seem convenient to me to deal in this work with *P. americana*, the other species of this sub-genus; there are in this collection a couple of mature individuals of this species. *Conchoecia striata* is presumably incorrectly determined, but the material is so poor that it does not seem to be possible to arrive at a certain identification; I have accordingly refrained from trying to give any definite answer to the question as to the identity of this form.

Professor G. W. MÜLLER kindly sent me at my request specimens of *Cypridina (Vargula) antarctica* G. W. MÜLLER and *Asterope teres* (A. M. NORMAN); for the result of my re-examination of these specimens see the former species below and my remarks under *Asterope Mülleri*.

For the purpose of carrying out a verificatory investigation I wrote to Professor G. S. BRADY for specimens of *Asterope Mariae* (W. BAIRD) and *A. teres* (A. M. NORMAN). I obtained a mature female of the latter species; for the result of my investigation of this specimen see *Asterope Mülleri* below. I also received five specimens of the former species; the result of my investigation of these will be found under *Asterope aberrata* and *A. norvegica* below.

* One specimen of the sample labelled *Conchoecia spinirostris* was, however, a mature female of *C. bispinosa* C. CLAUS; see this species below.

Only two of the species from the „Michael Sars" (see *Gigantocypris Mülleri* and *Cypridina (Macrocypridina) castanea*) have been treated in the present work. All the other Ostracod species of this expedition will be treated in a special work that I am preparing.

The first impulse to my studies of the marine Ostracods came from my highly esteemed teacher, Professor A. APPELLÖF, Upsala. It is with real pleasure that I take this opportunity of expressing to him my sense of gratitude — which has become more and more profound in the course of years — for the untiring interest with which he has followed the development of my work and for the never failing kindness and sympathy he has shown me on the numerous occasions when it was necessary to ask for his help.

To Professor A. WIRÉN, the head of the Zoological Institution of the University of Upsala, where, as I pointed out above, the greater part of this work was carried out, I beg to express my gratitude for all his kindness and interest during the past years.

At the same time I wish to thank the following persons as well for the help they have rendered me in connection with this work: Professor H. THÉEL and Phil. Dr. N. ODHNER, Swedish State Museum, Stockholm, Dr. H. ÖSTERGREN, Kristineberg, Professors G. O. SARS and T. ODHNER, Christiania, Professors G. W. MÜLLER and G. S. BRADY, Dr. M. v. DAVIDOFF, Laboratoire Russe de Zoologie, Villefranche-sur-Mer, Dr. J. RICHARD, Musée Océanographique de Monaco, Mr. HENRY ALEXANDER, lecturer in English at the University of Upsala (for his skilful and untiring work in translating the present work), Herr G. LILJEVALL (drawings of some figures; see *Philomedes (Scleroconcha) Appellöfi*), Herr J. W. ENGLUND (Indian ink reproductions of most of my drawings of the group *Cypridiniformes*), Fröken AMY WASTFELT (Indian ink reproductions of my drawings of the *Halocypriformes* and *Polycopiformes*, some of the figures of the *Cypridiniformes* and all the figures in the general part of this work) and Fröken GERDA JUNGBERG (the first two drawings of *Cypridina (Siphonostra) spinifera*).

Finally I wish to tender my heartfelt thanks to Herr H. MANNHEIMER, Bank Director, of Gothenburg. Owing to the present difficult conditions and the abnormally high prices, the printing of this treatise seemed almost impossible, and it is only because this exceedingly generous benefactor stepped in and, together with some friends of his, made the financial side secure that I have been able to have it printed.

INTRODUCTION.

„It seems to me most desirable that minute, and even apparently trivial, features should be given in the descriptions of species“.

C. STEWART *

In the present work there has been collected under the title of „Studies on marine Ostracods". Part I a part of the results that have proceeded from the investigations that I have carried out during the last few years on the marine representatives of the Ostracods, a group of *Crustacea* which is in many respects particularly interesting, both to the zoologist and the geologist.

This work is not a monograph; the reasons for this.

One criticism that may possibly be made against this work is that although it is rather voluminous, it has not the form of a monograph; a number of the many problems presented by the marine Ostracods have been left quite untouched, and my efforts have been concentrated on others — some of them very heterogeneous in their nature.

I must readily admit the justice of this criticism. The type of the work seems anything but satisfactory to myself. It is, as the title itself shows, a conglomeration; some of its integral parts are quite independent of each other.

Although the marine Ostracods have been treated by a number of investigators in a comparatively large number of works, it may be said not without justification that, on account of the uncertainty and superficiality that characterizes the great majority of these works, they constitute a subject that in many respects is almost entirely unknown. Under these circumstances it would of course have been most convenient to have directed these studies on a smaller systematic unit, for instance one family or even one genus, and to have submitted this to a fundamental and comprehensive examination or to have examined the Ostracod group as a whole from the point of view of a limited problem. In this way a result that was more favourable in many respects might certainly have been obtained and at the same time the treatise might have been more homogeneous from a structural point of view, a real unit.

As a matter of fact this was the direction I intended at first to take. My first studies were concentrated on the Cypridinids and Halocyprids.

* J. R. Microsc. Soc., London, 1880.

It soon became clear to me, however, that my investigations would have to proceed on other lines. There were several causes for this. The most important of these was the scarcity of material. A comprehensive and thorough examination of a group needs a material rich in specimens and comprising a comparatively large number of species. For several reasons the greater part of my work had to be carried out at Upsala and in this town there was only the not too abundant material of the Swedish museums at my disposal. Moreover, during the periods I spent at the west coast of Sweden in order to study O s t r a c o d s I soon discovered how sparsely these groups were represented there — both with regard to species and to individuals. I had the same experience as G. W. MÜLLER had previously at Naples with regard to the C y p r i d i n i d s; I found that specimens of these groups were so rare „dass ich bald die Lust verloren habe, besonders nach ihnen zu suchen" (G. W. MÜLLER, 1894, p. 2, remark). Because of the circumstances under which I was working it was thus necessary for me almost completely to accommodate my studies to a material which had, on the whole, been furnished once for all. A fairly abundant material was at my disposal in some groups and my work has expanded round these; other groups, on the contrary, could unfortunately be treated only rather cursorily because of the scarcity of the material both in species and individuals. This may — at least partly — explain and account for the conglomerate character of the present work.

I myself look upon this treatise only as a preparatory work for the really exhaustive monographs on the various divisions of the O s t r a c o d s and the problems connected with them, which are awaited by everyone.

Among the problems that I was faced with during my studies of the marine O s t r a c o d s and that can be advantageously dealt with on the basis of a material like that which was at my disposal there was, in my opinion, one especially that demanded a quick and thorough examination. This problem was that of classification and so I devoted most of my time and labour to it.

Other problems, such as the comparative morphology and histology of the forms, also need, of course, a new and thorough examination, as there is much to correct and add here too. They may, however, be said to be so well known already — especially from G. W. MÜLLER's large monograph, 1894, which is so rich in morphological and histological facts — that it is not absolutely necessary to reconsider them immediately if we are to have a sound development of our knowledge of this group of animals.

I do not mean by this that the main features of the current classification of the marine O s t r a c o d s are incorrect. On the contrary, as a matter of fact I think that it is only necessary to alter these very slightly. The O s t r a c o d s, like the A r t h r o p o d s in general, are characterized by what may be called a morphology that points outward. A consequence of this is that a quite modern revision of the classification of this group of animals — i. e. taking carefully into consideration as many characters as possible, both internal and external — is not likely to attain results that differ so much from those gained by older investigators whose work is marked not only by too little accuracy but by the fact that attention is paid only or practically only to external characters, as a modern investigation of the classification of, let us say, the lower groups of worms. The latter are characterized by a morphology that — if I may say

cod system are almost correct

so points more inwardly, their outer characters present only a few certain and phylogenetically important fixed points, while, on the other hand, a careful investigation of the inner structure in these groups is often likely to give good and important results.

What I refer to is the special classification . . . . .

Even at a rather early date HAECKEL put forward the supposition that the marine Ostracods might prove to be exceedingly rich in species. This supposition has been fully confirmed by the following investigations. Thus G. W. MÜLLER in his synoptic work on the Ostracods in „Das Tierreich“, 1912, includes no less than 1719 living Ostracod species and of these the marine forms compose the vast majority. To judge from the most recently published works and from the experience I had myself in working out this treatise, the number is, in addition, far from exhausted.

Under these circumstances it would be a great pity if the quality of the descriptions of the species were not to correspond to their quantity.

Even in FR. DAHL's work on the Cytherids of the Baltic, 1888, we find on p. 1 the following statements, unfortunately only too true, which throw light on this state of affairs: „Ich mußte aber bald einsehen, daß sich schon dem Vorstudium zu einer solchen Arbeit, d. h. der Bestimmung der Arten, ganz erhebliche Schwierigkeiten entgegenstellten. Selbst nach eingehender Prüfung konnte ich nicht mit Sicherheit angeben, ob meine Bestimmung wirklich richtig sei. Es lag dies theils daran, daß in der vorhandenen Literatur gar keine oder ungenügende Zeichnungen vorliegen, und doch dürften gerade in dieser Thiergruppe genaue Zeichnungen unbedingt nothwendig sein . . . .“

G. W. MÜLLER states that, out of the 1719 Ostracod species included in his work of 1912, only 921 are to be considered as „sichere“, the remaining 798 are „unsichere Species“. My own experience goes to show that even a rather considerably greater percentage of these species are to be denoted as uncertain.

On a closer study of the numerous diagnoses of marine species of this group that are found in the literature one cannot but be struck almost continually by two facts: first the indefinite and uncertain nature of all that is written and secondly the fewness of the characters that are taken into consideration.

Most of these species are, as a matter of fact, so superficially described and reproduced — the diagnosis consists only of a general description of the habitus — that certain identification is quite impossible merely because of this.

This superficiality has had the result that obvious errors have very often crept in. Only a few authors, such as G. W. MÜLLER and N. HIRSCHMANN, seem to have troubled about any great exactitude with regard to details. But not even they can escape criticism for lack of care, a fact that I had an opportunity to observe, for instance, in the case of G. W. MÜLLER, in a number of verificatory investigations. As the conditions now are, it is at least equally probable, in the cases where a difference is found between the form investigated and the description or figure of a species formerly treated in the literature, that this deviation is due to lack of precision in the description or the figure as that the difference actually exists.

In arriving at a certain identification of species at least as much trouble is caused by the fact that too few characters have been taken into consideration as by the lack of exactness in preceding writers. A very large number of species, for instance, have only the characters of the shell described. G. S. BRADY wrote, 1868 a p. 112: „By far the greater number of *Ostracoda* at present known have been described from fossil specimens"; in the original descriptions of these forms of course only the characters of the shell have been taken into consideration. A rather large number of these species have been since identified with living forms, but the extent of the descriptions has not, however, been increased. G. S. BRADY himself has afterwards very much increased the number of species that are only described by shell characters. A good illustration of this undesirable state of affairs is also shown by the fact that in G. W. MÜLLER's large monograph on the Ostracods of the Bay of Naples, undoubtedly the foremost work on this group of animals that we possess, the author has only included characters taken from the shell and the penis in the diagnoses of the great majority of the very numerous species belonging to the family *Cytheridae*. The appendages, their number of joints, bristles, etc. are, on the other hand, as a rule not included at all in these diagnoses. To this may be added that in almost all cases only a few appendages of these forms are reproduced. A number of this author's later works, e. g. that of 1908, are even worse in this respect.

The situation in most groups is really such at the present time that if the locality of the find is situated near the type locality of a previously described species one may venture perhaps — though with hesitation — to establish identity, but if the two localities are situated in regions that from the point of the view of their fauna are different one is inclined not to make an identification, although there are no differences according to the diagnosis of the species and the figures. Only a few descriptions of species that have been carried out so far can really be considered so complete and certain that merely on the basis of a comparison with them it is possible to distinguish minor systematic units, e. g. geographical sub-species.

A natural consequence of the above-described uncertainty and incompleteness of the descriptions of species is that the diagnoses of genera and families in this group of animals are also characterized by great uncertainty and incompleteness. Even the diagnoses of genera and families found in G. W. MÜLLER's above-mentioned large monograph, 1894, are anything but satisfactory. Only a comparatively few characters are included in these. This is of course due to some extent to the fact that this investigator only had an opportunity of personally investigating in detail a rather limited number of species in each group, but on the other hand his intentions do not seem to have extended very far. A single typical example may be given: In the diagnosis of the family *Nesideidae* we read concerning the mandible, p. 265: „Die Mandibel mit kräftigem Kaufortsatz, der 4 längere, 3 spitzige und einige kleinere, einfache Zähne trägt, zwischen den Zähnen entspringen Borsten; Taster deutlich viergliedrig; das letzte Glied mit starker Klaue; die Athemplatte mit wenigen (3) Strahlen, von denen einer außerordentlich lang ist." In the diagnoses of the two genera of this family *Nesidea*, p. 267, and *Bythocypris*, p. 275, this limb is not mentioned at all. The same thing is also true with regard to the diagnoses of the ten species belonging to the former genus and with regard to the diagnosis of the only species of the genus *Bythocypris*. This limb is only men-

duced for a single one out of all these eleven species, namely *Nesidea frequens* (G. W. MÜLLER). Is the mandible quite similar in all these species or is it subject to variation? No information is given on this point.

It is to be noted that N. HIRSCHMANN is his very fine essay on the Ostracod fauna of the Gulf of Finland, 1912, has given a good diagnosis of the genus *Cythere*.

[illegible] factory.

In identifying previously described marine Ostracods most investigators also show very great superficiality and uncertainty.

The most striking instance of this is probably J. G. EGGER. In 1901 this writer published a work called „Ostracoden aus Meeresgrundproben, gelothet von 1874—76 von S. M. S. Gazelle". Out of 149 species included in this work no less than almost half are stated to have been previously found in Europe in a fossilized condition, in post-tertiary, pliocene, miocene, oligocene, eocene and chalk. Most of these species were from antarctic regions and had not been found living in our Scandinavian seas. In other words, according to this author there was a great resemblance between the present antarctic Ostracod fauna and the Ostracod fauna in Europe during the tertiary and chalk periods, a state of affairs, which, if it turned out to be correct, would be of the greatest interest. G. W. MÜLLER, however, undertook an investigation in order to test the identifications of this author and arrived at a really surprising result: scarcely a single one of them was correct. G. W. MÜLLER writes as follows about this 1908, p. 144: „Eine solche Nachprüfung ergibt, daß kaum eine Bestimmung richtig ist; ich habe zurzeit eine größere Zahl von Bestimmungen geprüft und nicht eine richtig gefunden. (Vor Jahren habe ich die sämtlichen Bestimmungen geprüft, die Resultate sind mir zurzeit nicht zugänglich; soweit ich mich entsinnen kann, ließ sich nur eine Bestimmung mit einiger Wahrscheinlichkeit aufrecht erhalten.)" It seems to me beyond all doubt that G. W. MÜLLER's view is correct.

Good instances of this state of affairs are also found in G. S. BRADY's work on the „Challenger" Ostracods. Pl. XXIV in this work affords, for instance, a very good proof: *Cythere dictyon* G. S. BRADY, which, according to the statements of this author, seems to have a cosmopolitan distribution, is certainly not a natural unit.

Another very striking proof of this uncertainty will be found below in the remark under *Asterope aberrata*.

In short everything is vague in this field of work . . . .

[illegible] de-scriptions of species.

This state of affairs cannot continue. A firmer basis must be created for the classification and so for all our knowledge of this group of animals. The classifier must make his methods of description more strict. The general descriptions of habitus which pay attention to only a few organs must disappear. Greater and greater exactitude must replace dilettantism. As many organs as possible must be subjected to a careful investigation and described correctly, attention being paid to the variety of the details. — In an essay entitled „Prinzipien der Systematik, etc.", 1914, L. PLATE put forward, p. 95, the following fundamental principle for modern classification: „Jedes konstante Merkmal kann zur Trennung von Unterarten und Arten verwandt werden." The characters for distinguishing the different systematic categories may be obtained equally well

from physiology and oecology as from morphology. We have not the right to prefer one character to another. We must try to give a picture that is as correct and complete as possible of the species as we find it in nature. This programme puts a gigantic task before us, but nature is work.

Some reasons for the new method.

It is of course not only from the point of view of the identification of species that it is desirable to pay attention to as many characters as possible. The descriptions of species are not only useful for a barely certain identification. They are also to enable us to decide the mutual relationships of the forms described. The descriptions of the species form the basis on which in most cases the investigation of the natural system of a group almost exclusively must rest.

If attention is paid to only a few organs this obviously presupposes that the characters that are not taken into consideration are quite constant or, if they are variable, that their variation is accompanied by correlative changes in the organs that are included in the diagnosis or of which reproductions are given. A constancy or correlation of this kind seems of course, even a priori, very improbable. I myself have observed a great many instances in which it does not exist.

A good illustration of this is shown by the two species described below belonging to the sub-family *Cypridininae*, namely *Cypridina (Doloria) levis* and *C. (D.) pectinata*. — I may mention in passing that these two forms played a considerable part in the development of my studies of this group of animals, as it was during the examination of them that I realized the necessity of departing from the old-established superficial methods of investigation and description. — These two species show a striking resemblance with regard to the length and the type of the shell, the endopodite of the second antenna, the seventh limb and the furca, in other words, those organs to which in the group *Cypridiniformes* (cf. below) attention had hitherto been almost exclusively paid. I too assumed at first that they were quite identical. Only after the number of species investigated by me was increased and I had observed that there was a great difference between the Ostracods of South Georgia and those of the Falkland Islands — Tierra del Fuego did I undertake a detailed re-examination of specimens from both these regions paying attention not only to the organs mentioned above but to the other organs as well. It was only then that I discovered that this was a case of two very well differentiated species and that profound differences were present, especially in the maxilla and the fifth limb, in other words two organs to which practically no attention had formerly been given in this group.

As a proof of how necessary it is to observe carefully in each form the conditions of the various characters and not to attempt a premature generalization, some examples may also be given, taken from forms treated in the present portion of my work. In the sub-genus *Cypridina* the number of furcal claws is quite constant. In some other sub-genera and genera of the sub-family *Cypridininae* this character is constant in each species, but on the other hand it is variable for the sub-genus or genus considered as a whole. Finally in a number of species in this sub-family the number of the furcal claws differs not only from individual to individual but sometimes even on the two furcal lamellae of the same individual. Similar conditions may

also be observed with regard to other characters in this sub-family, e. g. the number of filaments on the sensory bristle of the fifth joint on the first antenna. — The bristles on the second and third endite of the protopodite of the fifth limb showed complete constancy with regard to number and almost with regard to type in all the species of the sub-family *Cypridininae* that I had an opportunity of closely investigating. The bristles on the first endite of the protopodite of this limb were with equal regularity subject to variation both in number and type. Curiously enough the species of the sub-family *Philomedinae* that I investigated showed quite opposite conditions. In these the bristles on the first endite of the above-mentioned limb were quite constant in number and their type too showed a rather marked constancy. On the other hand the bristles on the second and third endites of this limb varied. — In this connection I may point out as a curious fact the constant appearance of the three medial bristles inside the rostral sinus of the shell in *Doloria*, *Vargula*, *Macrocypridina*, *Siphonostra*, *Cypridina* (sensu str.) and *Cypridinodes*, sub-genera which presumably constitute a natural unit within the sub-family *Cypridininae*. The medial bristles situated near these three bristles are, on the other hand, subject to considerable variation. This shows how in a rather large group details that are apparently quite insignificant may remain constant.

But it may be said by some that such small characters, such as bristles, etc., in which the present work abounds, cannot, of course, be constant as a rule. With regard to this I wish to state two facts. In cases in which I had an opportunity of carefully investigating a large number of specimens of the same species, some hundreds for instance, as in the case of *Philomedes globosa* (W. LILLJEBORG), *Pontocypris monstrosa* G. W. MÜLLER, some new species of the genera *Pontocypris*, *Xestoleberis* and *Krithe*, I found such small characters surprisingly constant. (Of course no general conclusions are drawn from this.) In addition it is to be noted that the variability of a quality in a species is to the classifier a fact of equal or almost equal importance as the constancy of a character. If these small characters are not constant this must be established.

[illegible] thorough revision of the species hitherto described must be carried out.

What is specially necessary under the present circumstances is of course a thorough revision of the great majority of the species hitherto described. In doing this it would be best to proceed very radically with all the forms that are not described so well that they can be identified with complete certainty and of which it can be proved that there are no type specimens in existence. Unless there are special reasons for not doing so, these species ought not to be taken into consideration any further; it would be best to consider them as non-existent. It does not seem right to devote a great amount of work to setting up more or less long lists of synonyms, in which most of or sometimes almost all the names ought really to be followed by a query; from a scientific point of view such lists do not seem to be any gain.

In the same way it seems necessary to deal very radically with identifications made from species that are described in an unsatisfactory way, whether they are nomina nuda or unsatisfactorily re-described. In the first place these should not — unless, of course, there are special reasons — be included in lists of synonyms and secondly they should not be used in zoogeographical investigations if the specimen or specimens on which the statements in question are based are not still in existence.

I have unfortunately had no opportunity of contributing to any great extent to this work of clearing the path of study. The conditions brought about by the war were a decisive obstacle to this. I have only succeeded in getting type specimens of a few previously described species; see the preface.

The main object of this work of mine became consequently to make as large a number of species well known as possible. . . Although now that the first part of this work is nearing its close I feel that I have not attained the precision and comprehensiveness at which I ventured at one time to aim, yet I put forward the results that I have obtained in the hope that the descriptions given below may prove to be satisfactory both for certainty in the identification of species and for establishing the positions of the forms in question in the natural system.

Difference between external and internal characters.

L. PLATE, in his above quoted essay „P r i n z i p i e n d e r S y s t e m a t i k, etc.," 1914, writes, p. 148: „Ganz allgemein läßt sich behaupten, daß die äußerlich sichtbaren Organe der Tiere schon aus dem Grunde zur Diagnose besonders geeignet sind, weil sie viel veränderlicher sind als die inneren. Nah verwandte Arten sind häufig nur an solchen Differenzen der Hautskulptur, der Färbung, der Hautanhänge, der Schalen, der Sinnesorgane zu unterscheiden, während sie in den inneren Organen gleich oder fast gleich gebaut sind. . . . Selbst Arten aus verschiedenen Gattungen sind gar nicht selten an inneren Organen nicht zu erkennen." I have made the same observation with regard to the marine O s t r a c o d s. The external characters are much more variable than the internal ones, a state of affairs that, as L. PLATE writes (loc. cit.), is presumably due to the fact that the former „von dem beständigen Wechsel der äußeren Faktoren in erster Linie getroffen werden". As a rule only the higher systematic units differ from each other in the internal characters, such as the digestive organs, the inner sexual organs, etc. One consequence of this is that in the descriptions of species and genera I have given below I have dealt almost exclusively with outer characters taken from the shell, limbs, furca, the outer sexual organs and sensory organs. — The inner characters, the nervous and the digestive systems, the inner sexual organs and musculature, which have been partly worked out in a very meritorious way by preceding authors, for instance G. W. MÜLLER, 1894, I hope to have an opportunity to deal with in more detail in a subsequent work in connection with a comparative morphological study of these forms.

M[illegible]

A consequence of the incompleteness and uncertainty of the great majority of the preceding descriptions of species is of course that it is at present often quite impossible to decide the value of a character from a systematic point of view, i. e. it is impossible at present to establish detailed family and genus diagnoses of a definitive nature. It is therefore necessary, when more detailed diagnoses are now worked out, to burden the descriptions of species in many cases with a multitude of characters of a higher systematic value, characters which may gradually be transferred to genus or perhaps even to family diagnoses according as the number of the well described species increases. In the cases where I had a comparatively abundant material of the same family or genus at my disposal I worked out comparatively detailed family and genus descriptions in order to avoid too much repetition. In these descriptions, which are to be taken as quite provisional, I have collected all or at any rate most of the characters that I found common to all the species of the family or genus in question that were investigated

by me and included in this work. In exceptional cases the same characters as were included in the genus diagnosis are also repeated in the diagnoses of the species. This was done when it seemed desirable to draw attention to these qualities because, to judge from the preceding literature, they were perhaps not common to all the species belonging to the genus in question.

No short, concentrated family and genus diagnoses, for the purpose of rapid orientation, have been given in the present work. For them the reader is referred to G. W. MÜLLER, 1912.

In order to obtain the greatest possible perspicuity all the diagnoses in this work have been carried out in as stereotyped a manner as possible. Each character has the same place in each diagnosis.

On account of the incompleteness of the preceding descriptions of species I have been unable to give, by the side of the comprehensive and comparatively unwieldy descriptions of species, short, summary and less unwieldy diagnoses of species. In those cases where a rather large number of species of the same genus have been dealt with, a key has been drawn up in order to compensate for this deficiency.

If a species that has already been described in the literature is included in the present work a complete re-description of this is given when the original description is very incomplete or obviously incorrect; otherwise only a suplementary description is given.

In some descriptions the male is given first, in others the female. The cause of this inconsistency is either to be found in the nature of the material at my disposal or in the fact that in some genera one sex — either the male or female — is easier to characterize with certainty than the other.

The absence of any information about a character in a species must not be taken as indicating that in this character the species in question agrees with the most closely related form. It only means that there is no information about it!! Statements as to pilosity are exceptions to this rule. The absence of information as to this means that I found the organ in question quite smooth.

In the cases where no special remark is made about the constancy of a character in a species this means that the character was practically constant in all the specimens examined by me. It is of course left to subsequent investigators to discover how far this constancy extends. It is to be noted that I often had a rather small amount of material of each separate species at my disposal. In those cases where there was more abundant material of a species a number of specimens have always been carefully investigated with regard to all the characters included in the descriptions. It might quite justifiably be remarked that I ought to have stated how many specimens of each species were carefully examined. By means of this a more certain idea of the constancy of the separate species would, of course, have been obtained. The reason why this information is not given is that it was unfortunately not included in the original records of my investigations.

It may perhaps seem superfluous to have given both exhaustive descriptions of species and detailed figures. The reasons for this are as follows: 1) in studying the figures given by preceding authors I often felt uncertain as to the interpretation of details, 2) in many cases it was impossible to show all the details and to modulate them on account of practical reasons

— the small size of the figure, the method of reproduction, etc. — 3) it seemed exceedingly important to give a verification of the figures by means of the text.

With regard to the description of the shell we must note: All shell measurements are taken by means of an ocular micrometer. Like most preceding authors I have, when measuring the length of the shell, included any processes that were present, e. g. the rostrum, spines, etc. In his measurements of Halocyprids and Cypridinids G. H. FOWLER, 1909, measured „parallel to the dorsal border from the most prominent part of the anterior border, ventral to the niche for the second antenna" to the most projecting part of the posterior border, leaving out of account any spines that might exist. This method of measuring was to give „a real measurement of the shell, which is comparable in different species" (loc. cit. p. 222). As I never had any need of any such „real" values, I have, as stated above, employed the method used by other investigators.

G. W. MÜLLER writes, 1894, p. 9, as follows: „Die meisten Untersuchungen an der Schale können mit Erfolg nur an isolierten Schalen vorgenommen werden, besonders sollten Profilzeichnungen nur nach ihnen gemacht werden . . . ." This principle has been applied to as great an extent as possible in the present work. Only in cases where it was impossible, on account of the soft condition of the shell, to separate the two valves without destroying the form has the profile been drawn from the whole shell. In the latter case the body was almost always first removed from the shell. „Man ist dann leichter im Stande, das Thier in die Profillage zu bringen" (G. W. MÜLLER, 1894, p. 10).

During the drawing of the profile the shell is most conveniently fixed, if it is drawn whole, by means of gelatinous glycerine.

G. W. MÜLLER writes as follows in his work of 1894, p. 9, with regard to the shell: „Man untersuche, wenn auch vorwiegend, so doch nicht ausschließlich in Canadabalsam oder Nelkenöl, sondern auch in Glycerin, eventuell auch in Wasser oder Alkohol, da häufig Einzelheiten der Sculptur in Canadabalsam vollständig verloren gehen." To this it may be objected that it is absolutely necessary to investigate and reproduce sculptured shells in a dry condition and in reflected light. If the shell is investigated in a liquid we may easily obtain a mistaken idea of the sculpture whether we use reflected or transmitted light. — The reproduction of the sculpture as it appears in transmitted light is of course inconvenient, because by this the identification of fossil forms is rendered much more difficult.

The figures of the shells ought to be made comparatively large and as similar in details as possible; generalized and minute figures, such as those of G. S. BRADY, are of little use to us; sculptured shells ought to be reproduced by means of shaded figures, not figures of the type given by G. W. MÜLLER in his work of 1908; unsculptured shells are drawn most conveniently in transmitted light and without any shading.

The cross-striation of the selvage is most often very slight; it is exaggerated in the drawings in order to show what is selvage.

In describing the limbs we must note: The relative length of the joints of an appendage has sometimes been shown below in a way that is illustrated by the following example: I $\frac{17}{14}$; II $\frac{23}{13}$; III $\frac{6}{3}$ . . . . VIII 0.5. Here the roman figures denote the numbers of the

joints, the figures above the line denote the relative length of the joints on the dorsal or anterior side, the figures below the line the relative length of the joints on the ventral or posterior side.

I may point out in passing that when I speak below of bristles that are more or less finely pectinated distally, this pectination is presumably always in two rows, even if it is shown in one row in the drawing; the two rows of spines are often situated on the same side, so that what is apparently one row of pectination seems to be present. This pectination could, of course, only be reproduced in outline.

It is often rather difficult to estimate the number of bristles because they are situated so close together. G. W. MÜLLER complains about this, 1894, p. 28 . . . . „Wer die Schwierigkeit einer genauen Feststellung dieser Verhältnisse kennt . . . .“ I think I have overcome this difficulty, at least partly, by a simple manipulation: the limb (in glycerine) is crushed by a slight pressure on the cover-glass and then the latter is moved, if desired, in different directions. By this procedure bristles that are placed close to each other are separated. I have obtained very good results with this method. Chitinous parts ought not to be reproduced from fresh material; the material ought first to be hardened in alcohol, or else the chitinous parts are too strongly compressed by the cover-glass and misleading images arise.

In the descriptions given in this work the p e n i s is described rather superficially, but I hope that the drawings that are given of this organ will, in spite of their being done in outline, prove to be sufficiently detailed to permit of quite certain identification of species. I hope to have an opportunity in a subsequent work to give more detailed descriptions and reproductions of this organ which is so interesting from a morphological point of view.

Statements of frequency.

Although it is almost always stated below how many specimens of each species were caught, this information cannot be used, except with very great caution, as an indication of the frequency of the forms in question, as the samples that were investigated were not collected for comparative quantitive investigations.

Plankton samples.

All the plankton samples were caught in open nets. The statements as to depth given under these forms are consequently of comparatively little value.

Statements of locality.

All statements as to the longitude of the localities are made with reference to Greenwich.

Historical resumés.

A historical resumé is given after each of the higher systematic units, sub-families, families, etc. These resumés deal chiefly with the historical development of our knowledge of the classification of the Ostracod group and the organs that are most important for the special classification, the shell, appendages, external sensory organs, etc.

Final remark.

Before ending this introduction and giving the results of my investigations I wish to quote a statement made by TH. MORTENSEN in his distinguished work on the Echinoids of the Ingolf Expedition, 1903, p. 3: „D e t v i s t e s i g, a t D y r e n e v a r s a e r d e l e s g o d e a t h a v e m e d a t g ø r e, A r t e r n e m e g e t v e l k a r a k t e r i s e r e d e. D e t e r L i t e r a t u r e n, d e r b r i n g e r V a n s k e l i g h e d e r n e g e n n e m d e n U e n d e l i g h e d a f d a a r l i g e B e s k r i v e l s e r, d e n r u m m e r.“* This remark coincides entirely with the experience I obtained myself in carrying out the present work.

* *Translation:* The animals proved to be very good to work with, the species were very well distinguished. It is the literature that causes difficulty on account of the great number of poor descriptions it contains.

GENERAL PART.

CHAPTER I.

General terminology.* With a discussion of the general morphology of the limbs.

With regard to several terminological questions connected with the Ostracods there is still, unfortunately, considerable confusion and uncertainty in the literature. Because of this some of these problems have had to be subjected to a new treatment in the present work. The most important of these is the general terminology of the limbs, a problem which can scarcely be dealt with except in connection with a discussion of the general morphology of these organs. In the case of others I have had to define my standpoint with regard to the views of previous authors.

Shell: —

With regard to the shell the terminology worked out by G. W. MÜLLER has been used in this work. — For the term „Saum" I have used „selvage", the word used by G. H. FOWLER, 1909 (see, for instance, p. 257). — When „shell, seen from the side" appears in the explanations of the drawings, this means that the figure is drawn from the whole shell; when the word valve is used, the figure is drawn from a detached valve.

Limbs: —

The names of the limbs: — W. GIESBRECHT, in his essay „Mittheilungen über Copepoden", 1893, p. 102, after having first pointed out a number of inconsistencies that previous writers had been guilty of in the terminology of certain limbs, utters the following noteworthy words: „denn wenn die Namen der Gliedmaßen auch ursprünglich nach ihrer Function gewählt sein mögen, so ist doch als Princip festzustellen, daß die homologen Gliedmaßen mit gleichlautenden Namen zu benennen sind, und man derselben Gliedmaße nicht nach ihrer, zuweilen in derselben Ordnung wechselnden Function verschiedene Namen belegen darf."

* The questions of the special terminology have been dealt with in connection with the problems [illegible] are related.

In the Ostracod literature too there is lamentable inconsistency and confusion in the denomination of certain limbs, especially with regard to the three posterior ones. This is due to a great extent to the very fact that the functions and not the homology of these organs have been taken as a basis for the terminology. Thus J. D. DANA, the first writer to interpret the appendages of the Cypridinids correctly, names the three posterior limbs as follows in his work of 1852.*

In the Cypridinids	the second pair of maxillae	(the fifth pair of limbs)
	.. third	(.. sixth .. .. ..)
	.. foot	(.. seventh .. .. ..)
In the Cyprids	.. second pair of maxillae	(.. fifth .. .. ..)
	.. first .. .. feet	(= .. sixth .. .. ..)
	.. second	(.. seventh .. .. ..)
In the Cytherids	.. first	(.. fifth .. .. ..)
	.. second	(.. sixth .. .. ..)
	.. third	(.. seventh .. .. ..)

We find the same terminology also employed, for instance, by G. O. SARS, 1865, C. CLAUS, 1865, G. S. BRADY, 1868 a and b, and on the whole by G. S. BRADY and A. M. NORMAN, 1889 and 1896. G. O. SARS has also used this terminology on the whole in his work of 1887. Only in the case of the last two pairs of limbs in the Cypridinids are there variations in this work; these limbs are called either the next to the last and the last pairs of limbs or the first and the last pairs of limbs.

The terminology of the appendages used by G. W. MÜLLER in his large monograph of 1894 is also very inconsistent — perhaps even more than that of the other authors. Thus in the special part of this work the three limbs in question are called:

In the Cypridinids	the second maxilla	(the fifth pair of limbs)
	.. first limb	(.. sixth .. ..)
	.. cleaning ..	(= .. seventh .. .. ..)
In the Halocyprids and Cyprids	.. maxillar ..	(.. fifth .. .. ..)
	.. first .	(.. sixth .. .. ..)
	.. second ..	(= .. seventh .. .. ..)
In the Nesideids and Cytherids	.. first ..	(.. fifth .. .. ..)
	.. second ..	(.. sixth .. .. ..)
	.. third .	(.. seventh .. . ..)

In the same part of this work the fifth limb of the Polycopids is termed simply „Fuß" and the fifth and sixth limbs in the Cytherellids are called the third and fourth post-oral ** limbs. In the general part of this work G. W. MÜLLER usually calls these three

* With regard to these appendages in the Halocyprids this writer has committed very serious mistakes.

** For the term post-oral see p. 21 below.

limbs the fifth, sixth and seventh limbs or the third, fourth and fifth post-oral limbs; sometimes, however, he uses the terminology employed in the special part in this part as well.

Referring to the above quoted statement of W. GIESBRECHT, G. W. MÜLLER points out, however, even in this work the desirability of employing a consistent terminology for these organs, based on their homology. Then he writes, p. 195: „... . . . Die Bezeichnung, ohne Rücksicht auf die Function, einfach von der bei anderen Krebsordnungen zu entnehmen, scheint mir schon wegen der Unsicherheit der Homologie unzulässig. So wäre es wohl für spätere Arbeiten das Gerathenste, die betreffenden Gliedmaaßen einfach als 3., 4., 5. postorale oder schlechtweg als 5., 6., 7. zu bezeichnen wobei wir freilich wieder bedenken müssen, daß sie den 5., 6., 7. anderer Krebse nicht homolog sind.“

In his later works, in accordance with this statement, G. W. MÜLLER applies the same terminology for all appendages in all Ostracod groups. In these works the three posterior pairs of limbs are not, however, given names in accordance with any of his two suggestions quoted above, but are called instead: the first, second and third thoracal limbs. — Other authors, such as, for instance, G. ALM, 1915, have adopted this terminology.

On the other hand W. GIESBRECHT, who also uses a terminology that is applied consistently to all Ostracod groups, calls these three limbs in his work of 1913: the second maxilla, the first and second thoracopods.

Which of these suggestions is the most convenient to adopt?

Even in his above quoted statement of 1894 G. W. MÜLLER indicates, as is seen, that there is difficulty in carrying out a certain homologization between the appendages of the Ostracods and those of other Crustacean groups. The difficulty there indicated is the uncertainty with regard to the interpretation of the fifth limb of the Ostracods. While some investigators (for instance, G. O. SARS and W. GIESBRECHT) are of the opinion that the fifth limb of the Ostracods is homologous with the second maxilla of other *Crustacea*, other writers (G. W. MÜLLER among them) definitely state that this limb in the Ostracods is to be taken as homologous to the first thoracal limb in the higher *Crustacea*, the second maxilla being quite absent in the Ostracods. To support this opinion of his G. W. MÜLLER in his work of 1894, p. 179 brought forward a noteworthy argument from the embryology of the Cyprids. He points out that while a new limb appears at each of the first, third, fourth and fifth larval moults, no new appendage is formed at the second larval moult, the moult at which the second maxilla ought to appear. He illustrates this state of affairs by the following table:

Stage	Number of the limbs.
1 (nauplius):	1st, 2nd, 3rd
2	: 1st, 2nd, 3rd, (4th)
3	: 1st, 2nd, 3rd, 4th (*)
4	: 1st, 2nd, 3rd, 4th * (5th)
5	: 1st, 2nd, 3rd, 4th * 5th (6th)
6	: 1st, 2nd, 3rd, 4th * 5th, 6th (7th)
7	: 1st, 2nd, 3rd, 4th * 5th, 6th, 7th

A bracket round a figure denotes that the limb with this number is only found in the form of „stummelförmige, ungegliederte oder undeutlich gegliederte, meist auch unbewegliche Anlage“, a figure without a bracket denotes that the limb in question is more or less fully developed. * denotes the undeveloped second maxilla. The same state of affairs is also found in the family *Cytheridae* „die Lücke zwischen 4. und 5. Gliedmaaße tritt noch deutlicher hervor“ (1894, p. 182). I must leave the question open as to the value of this argument. It ought to be noted, however, that in the Cypridinids the development of the limbs is quite independent of the moults, a fact that I myself have had an opportunity of observing during very careful investigations of the embryology of these forms. Another argument for G. W. MÜLLER's view is perhaps to be found in the fact that in the Cladocers, which are presumably rather closely related to the Ostracods, this appendage is very much reduced; it is observable in young specimens, but it persists only very seldom in mature individuals (e. g. in *Sida* and *Moina*). On the other hand what we know so far about the nervous system of the Ostracods does not seem to support G. W. MÜLLER's opinion; it is to be noted, however, that our knowledge of this subject can by no means be said to be too certain. In my opinion, the problem of the nature of the fifth appendage in the Ostracods must still be considered as being unsolved. A very thorough embryologico-histological investigation is needed for the solution of this question.

On account of this I am of the opinion that it is not convenient at the present time to carry out a consistent terminology for the Ostracods in accordance with the principle laid down by W. GIESBRECHT.

There is in addition another reason, which seems to me rather strong, for rejecting the terminologies employed both by W. GIESBRECHT and by G. W. MÜLLER in his later works. In the *Crustacea* we understand by the thorax, according to modern terminology, if this term is taken as a strict morphological conception, the eight post-cephal segments in *Leptostraca* and *Malacostraca* as opposed to the cephalon and pleon of these forms. It seems as if this term ought not at all to be used in the case of *Entomostraca*. W. GIESBRECHT writes on this point as follows, 1913, p. 20: „Da also der vordere Rumpfabschnitt der *Entomostraca* dem stets aus 8 Metameren bestehenden Thorax der *Leptostraca* und *Malacostraca* nicht homolog ist, und außerdem sein morphologischer Inhalt (Metamerenzahl) auch innerhalb der *Entomostraca* variiert, darf man ihn nicht ebenfalls Thorax nennen, sondern wir bezeichnen ihn als Vorderrumpf und den hinteren Abschnitt als Hinterrumpf.“ If thus that part of the Ostracod body on which the three posterior appendages are attached ought not to be called the thorax, these appendages cannot, of course, be conveniently called thoracal either.

The homologization of the limbs in the different Ostracod groups that is now generally adopted seems, on the other hand, to be fairly well founded.

Starting out from these facts I have in the present work, like most of the preceding writers, termed the first four limbs of the Ostracods the first and second antennae, the mandible and the maxilla; in other words in the case of these organs I have employed the same terminology as that which is now used in other *Crustacea*. For the three posterior appendages I have tried to find terms that were neutral and at the same time followed

the preceding literature. For several reasons the terms: fifth, sixth and seventh limbs seems to me most convenient; i. e. in the case of these organs one of the two methods recommended by G. W. MÜLLER in his work of 1894 (cf. the quotation on p. 19 above) has been adopted.

Pre-oral limbs*: —

First antenna.

First antenna: — With regard to this appendage I follow the terminology used by G. W. MÜLLER in all essential points. On this appendage, as on all the following ones, the joints are reckoned proximo-distally, unless something is said to the contrary. In naming the different sides of the joints on this appendage, as on the following ones, the appendage is always thought of in its natural position of rest, unless something is said to the contrary. It is to be noted that the sides on which the joints border on each other are always called the proximal and the distal sides; if attention is paid to this, there is no danger of any mistakes.

Post-oral limbs.

Post-oral limbs: —

The post-oral limbs of the *Crustacea* may, as is known, be divided into three main types according to their structure: the leaf-like or foliaceous, the biramous and the rod-shaped limbs.

General description of the main types of the post-oral limbs of the Crustacea.

The first type is found in the Phyllopods and is characterized by W. GIESBRECHT in his work of 1913, p. 31 as follows: The leaf-like limb consists of a lamella with an anterior and a posterior surface and with medial, distal and lateral edges; the edges are provided with hairs and bristles and have lobes and processes. Its middle piece is called the protopodite, the lobes and processes are called exites, if they are situated on the lateral edge of the lamella, endites, if they issue from its medial edge. In a number of forms the protopodite appears to be — though sometimes only rather incompletely — divided into transverse joints. The exites and endites may sometimes not only be bounded from the protopodite but also divided more or less distinctly into joints themselves.

The second type of limbs is described by W. GIESBRECHT in his work just quoted as follows: The biramous limb consists of a trunk, the protopodite and two branches, an outer one called the exopodite and an inner one called the endopodite. Proximally of the exopodite and the endopodite exites and endites may occur on the protopodite; the former are called epipodites. The protopodite of the biramous limb is proportionately less strongly developed than in the foliaceous limb and is in most cases divided into two joints, the proximal one of which is called the coxale, the distal one the basale. It is to be noted that in most cases probably only the distal part of the protopodite of the leaf-like limb, the part that has the exites, is to be considered as homologous to the protopodite of the biramous limb; that part of the protopodite of the latter type which corresponds to the proximal part of the protopodite of the former type seems, in most cases, to have been more or less completely united to the body of the animal. Sometimes, when this union is less complete, one can, however, observe a joint or the remains of a joint between the coxale and the body; this joint is usually called the pre-

* G. W. MÜLLER in his work of 1894 considered both the first and second antennae as pre-oral. As is well known, the second antennae of all *Crustacea* have been shown to be post-oral.

coxale. The exopodite and the endopodite of the biramous limb are in most cases divided into a larger or smaller number of joints, which are usually distinct.

The third type, the rod-shaped limb, is usually well jointed and consists of a single row of joints.

The chief function of the foliaceous limb seems to be that of locomotion, swimming, and its secondary functions are those of respiration, carrying the food to the mouth, breaking up the food, etc. In the biramous limb these functions are differentiated and localized; the exopodite and endopodite are specially adapted for locomotion and the epipodial appendages especially are used in respiration; the endites on some of the limbs situated nearest the mouth are differentiated for the function of taking up food. The rod-shaped limbs are especially locomotory organs, functioning chiefly as organs for crawling and climbing.

…e most primitive?

Which of these three types is to be considered as the most primitive? This seems an exceedingly difficult question to answer.

It is rather common nowadays to consider, with RAY LANKESTER, the first type, the lobed foliaceous limb as most primitive (e. g. W. GIESBRECHT in his comprehensive work on the *Crustacea*, 1913). It is this type that we find in the Phyllopods, the group that is now generally and presumably correctly considered as the most primitive of all the recent *Crustacea* known at present.

Another view is maintained by C. CLAUS. This eminent investigator of *Crustacea* writes as follows in his important work of 1876, p. 17: „Demnach würden wir zu dem gewiß nicht unberechtigten Schlusse geführt, daß die Extremitäten der Stammkrebse, über deren Bau uns leider die ältesten paläontologischen Crustaceenreste zur Zeit keine Auskunft geben, keineswegs echte blattförmige Phyllopodenfüße waren, sondern den Gliedmaßen von Nauplius ähnlich, eine Annäherung an die Spaltfüße zeigten, welche nun um so leichter in einseitiger Streckung der Aeste, den sich nach einer anderen Richtung mehr flächenhaft gestalteten Phyllopodenfüßen gegenüber, ihre Eigenthümlichkeiten ausbilden konnten." According to this author (p. 16) the epipodial appendages are later acquisitions.

E. KORSCHELT and K. HEIDER seek the original type of the limbs of the *Crustacea* in the bifurcated parapodium of the Annelids. In their textbook of 1890, p. 389 these authors write as follows: „Man ist versucht, die typische zweiästige Form des Crustaceenbeines direct von der ähnlichen gegabelten Gestalt der Annelidenparapodien herzuleiten. Hierfür spricht die eben erwähnte Thatsache, daß die Sonderung von Exopodit und Endopodit sich an den Beinanlagen von *Branchipus* ungemein frühzeitig geltend macht." The endites are according to these authors new acquisitions; the epipodial appendages, on the other hand, are primitive organs, which „man wohl mit einiger Wahrscheinlichkeit auf Dorsalcirren der Anneliden beziehen dürfen". „Gegen letztere Auffassung spricht allerdings das verspätete Auftreten dieser Bildungen in der Ontogenie der Crustaceen. Doch darf man nicht vergessen, daß eine Steigerung des respiratorischen Bedürfnisses erst bei einer gewissen Körpergröße sich geltend zu machen pflegt und es somit erklärlich scheint, wenn kleine Krebslarven (ebenso wie ausgebildete Formen von geringer Körperentwicklung) der Kiemenanhänge entbehren."

J. THIELE also starts out from the idea that the parapodium of the Annelids is the original type of the Crustacean post-oral limbs. This author writes, 1905, p. 467:

„Die Ausgangsform des Crustaceenbeines, die jedenfalls auf ein Annelidenparapodium zurückführbar ist, dürfte die eines zweigliedrigen Blattes sein, dessen proximales Glied noch unvollkommen vom Körper getrennt ist und seine Muskulatur aus diesem empfängt, während das distale Glied noch ungegliedert ist und einen dorsalen blattförmigen Anhang trägt." (See fig. I.) With regard to the epipodial appendages this writer assumes, contrary to the two preceding writers but similarly to C. CLAUS, that they are „besondere Erwerbung der P h y l l o p o d e n und L e p t o s t r a k e n" (p. 466); as an argument for this he adduces the relatively late appearance of these organs during the ontogeny.

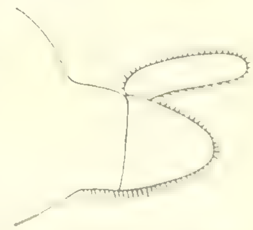

Fig. I. Diagram of the original type of the post-oral Crustacean limbs, according to J. THIELE. (From J. THIELE, 1905, p. 467).

With regard to the views of the three last-mentioned writers I wish to quote a statement of W. T. CALMAN. This author writes, 1909 a, p. 9: „It does not seem profitable . . . . to attempt, as some have done, to compare the limbs of the *Branchiopoda* in detail with the Polychaete parapodium". It is to be noted that in the *Archiannelida*, the Annelid group with the simplest structure, — whether this simplicity is original or secondary seems to be uncertain as yet — there are no parapodia at all. E. KORSCHELT and K. HEIDER have not attempted to give any more detailed reasons for their view — their statement is probably to be considered more as a whim than as a serious hypothesis. On the other hand J. THIELE has tried to produce arguments for his opinion, but his demonstration is anything but convincing. As a matter of fact one cannot, when studying his exposition, help reflecting that it would not be very difficult, using his method of proof and other facts, to „prove" other views of this question.

Homologization of

The biramous limb has — according to the first mentioned opinion — developed from the foliaceous limb. No agreement has, however, been yet reached as to which parts of the latter are to be considered as homologous with the exopodite and endopodite of the former nor in general as to the part that the different parts of the foliaceous limb have played in this development. As early as 1881, in RAY LANKESTER's essay on „A p p e n d a g e s a n d n e r v o u s s y s t e m o f *Apus cancriformis*", this author put forward the assumption that of the six endites that characterize „the second thoracic foot" of this species no. 5, counting proximo-distally, is homologous with the endopodite and no. 6 with the exopodite; cf. the accompanying fig. II. This view has been accepted in many quarters. On the other hand W. GIESBRECHT assumes in his work of 1913 — following J. THIELE — that the end part of the protopodite corresponds to the endopodite; the exopodite, according to this author, corresponds to the distal exite.

This uncertainty will be by no means surprising to those who have studied the morphology of the foliaceous limbs of the P h y l l o p o d s and have observed the great difficulty that is attached to carrying out a certain homologization of the lobes and processes of the different limbs in the different sub-groups of this group. See A. BEHNING, 1912.

It is supposed that the third main type of post-oral limbs, the rod-shaped limb, has arisen by the reduction and disappearance of one of the two branches of the biramous limb. Whether, as is now generally assumed, (cf. W. GIESBRECHT, 1913, p. 32) it is always the exopodite that disappeared, seems, according to what I believe I have observed, to be rather uncertain.

But in a number of cases, however, the rod-shaped limb appears to have developed directly from the foliaceous type. As an instance of this W. GIESBRECHT mentions, 1913, p. 33, among other things, „die stabbeinförmigen hinteren Maxillen und die ähnlichen Thoracopodien mancher Ostracoden“; for these forms see below.

It seems, however, to be by no means impossible that the development has sometimes proceeded in the opposite direction, that, for instance, more or less foliaceous limbs have been developed from biramous or rod-shaped limbs. Thus, even if we accept the assumption that the foliaceous type is the primitive one in the *Crustacea*, we are not by any means justified in assuming a priori that we have an original type every time we meet this limb.

Fig. 11. [illegible]

With regard to what might be called the morphological value of the different parts of the Crustacean post-oral limbs opinions also still differ. Thus E. KORSCHELT and K. HEIDER, in their work of 1890, are of the opinion that the exopodite and the endopodite are organs of equal value — they refer them, as we have seen above, to the two main branches of the Annelidan parapodium: when in a number of forms, especially among the *Malacostraca*, the endopodite forms a direct continuation of the protopodite, while the exopodite appears in the form of a more or less reduced appendage, this is — according to these authors — not to be considered as a primitive condition; cf. loc. cit. p. 388. On the other hand, according to these two authors the epipodial appendages are of a different nature from the exopodite and endopodite; they are, as we see above, p. 22 homologized with the dorsal cirri on the Annelidan parapodium.

J. THIELE protests against this view; in his work of 1905, p. 466 he writes as follows: „Dazu bemerke ich zunächst, daß nach meiner Auffassung die beiden Äste, Endopodit und Exopodit, ursprünglich durchaus nicht gleichwertig sind, sondern der erstere die einfache Fortsetzung des Stammes, der letztere ein Anhang desselben, daher kann man sie nicht wohl auf die gegabelte Gestalt der Parapodien zurückführen, sondern den Basipoditen mit dem Endopoditen auf deren Stamm, den Exopoditen auf einen dorsalen Anhang, etwa einen Cirrus.“

Neither of these two alternatives can be said to be proved in any way. So far both are to be considered as assumptions.

In my opinion there could originally scarcely have been any essential morphological difference either between exites

a n d e n d i t e s o r b e t w e e n t h e s e a n d t h e d i s t a l p a r t o f t h e p r o t o p o d i t e. These terms seem to be merely expressions for a classification of parts of the same organ which were originally similar, a classification based on the relative position of the parts to each other and to the organ, the limb considered as a w h o l e. The probability of this assumption ought to be obvious to anyone who has made a thorough comparative morphological study of the post-oral limbs of the P h y l l o p o d s.

The problem of the phylogeny of the Crustacean post-oral limbs must consequently as yet be considered as being far from settled. Our knowledge of the types of limbs that characterized the *Protostraca*, the hypothetical ancestral forms of the *Crustacea*, is still rather uncertain. The homologization of the different parts of the limbs in different Crustacean groups in many cases cannot be said to be proved.

Is it possible to carry out a certain homologization of the different parts of the multiform post-oral limbs of the Ostra-c o d s? In other words is it possible to carry out for this group as well the terminology employed above?

In discussing this very complicated problem we must, I think, pay special attention to the fact that, as I have just pointed out, there was presumably no essential and fundamental difference originally between the different parts of the limbs, the epipodites, the exopodite, the endopodite and the endites. The cause of their varied differentiation probably lies chiefly in their different positions. Thus the endites that were situated inside were destined to serve as organs for taking up food, the distally situated exo- and endopodites to develop into locomotory organs, natatory, crawling or climbing organs, the lateral epipodial appendages were to become especially respiratory organs of one sort or other.

Looking at it from this point of view, it can by no means be considered surprising or improbable if it should turn out that the exopodite of one limb were differentiated to fulfil a function which was connected with, let us say, the endopodite in the case of another limb of the same species or of the same limb in another group, or if the exopodite and the epipodial appendage of different limbs of the same species were differentiated in corresponding ways for the same function. As is shown by the following facts it may be considered quite certain that instances of such conditions occur in the O s t r a c o d s: In *Thaumatocypris* and *Polycopidae* both the exopodite and the endopodite of the second antenna are developed for a natatory function; in the C y p r i d i n i d s and most of the H a l o c y p r i d s the exopodite alone has taken over this function, the endopodite has been more or less reduced and adapted to quite different functions; in the males, for instance, it is used as an organ for seizing the females. In the C y p r i d s the endopodite of this antenna is adapted in a number of forms both for crawling and for swimming; in other C y p r i d s, as well as in the N e s i d e i d s and C y t h e r i d s, this branch is exclusively a crawling organ; in these three groups the exopodite is more or less completely reduced. In the C y t h e r e l l i d s both the exopodite and the endopodite are very powerfully developed and both of them are crawling and digging organs.

The post-oral limbs of the Ostracods are, as has just been pointed out, exceedingly multiform: the same limb often appears in such different types in the different groups that a certain homologization of its different parts seems to be almost hopeless. As a matter of fact the Ostracod group comprises such heterogeneous elements that one cannot expect a priori to find any far-reaching morphological agreement between actually homologous organs. Innervation, musculature, the number of joints, the bristle equipment, in other words the anatomical characters that are concerned, often completely fail to give a certain clue to the homologization.

Although facts obtained from comparative morphology and embryology have as far as possible been taken into consideration in discussing these problems, the determining factor has been, under these circumstances, the position of the parts dealt with, their relative position to each other as well as their position in relation to the limb taken as a whole. The results of homologizations carried out on so slight a basis as the positions must, of course, be both uncertain and unsatisfactory in many cases*; this is still more so as the situation of the different parts of the limbs is by no means constant.

G. W. MÜLLER, the only author who has discussed this problem in detail for the Ostracods, does not show quite clearly what principles he has followed in working it out. But this writer seems, at least in some cases, chiefly to have followed the last principle put forward by me above, i. e. the positions of the different parts has been taken by this author too as the determining factor. In other cases, on the contrary, other principles have been the dominant ones for this writer. As a result of this he has in many cases, as is shown below, arrived at results quite different from those put forward in this work.

Second antenna: — With regard to this limb I follow almost entirely the terminology found in G. W. MÜLLER's large treatise of 1894. According to this author this antenna is a biramous limb, consisting of a protopodite, an exopodite and an endopodite; on the other hand there are no epipodites and endites at all. The protopodite is sometimes single-jointed, sometimes two-jointed, sometimes it even has an indication of a third joint. The exopodite and endopodite are developed very differently in different groups; sometimes both these branches are well developed, as in *Thaumatocypris*, the Polycopids and the Cytherellids, sometimes the exopodite dominates decidedly over the endopodite, as, for instance, in the Cypridinids and most of the Halocyprids; sometimes the exopodite is very much reduced, the endopodite on the other hand, very large and powerful, as in the Cyprids, Darwinulids, Nesideids and Cytherids.

Before G. W. MÜLLER it was assumed that the natatory branch in the Cypridinids, Halocyprids and Polycopids represented the endopodite, the other branch the

* The difficulty of carrying out a terminology, based on a certain homologization, for the different parts of the Ostracod limbs, corresponding to that which has been accepted for other *Crustacea* may perhaps seem to justify the use, at least for the present, of a quite neutral terminology for this group. The reason why this method has not been chosen in the present work is that because, in my opinion, it would only increase the confusion in these questions.

exopodite („trotz seiner medialen Lage", as C. CLAUS points out in his work of 1891 a, p. 22).*
All the authors after 1894 too except E. v. DADAY, 1908, are opposed to G. W. MÜLLER in this question — if they take up any position at all with regard to it.

In spite of this it seems certain that the opinion put forward by G. W. MÜLLER is correct. „Dies ist eine nothwendige Folgerung aus der wechselseitigen Lagerung der betreffenden Anhänge" (G. W. MÜLLER, loc. cit. p. 44).

G. W. MÜLLER was of the opinion that he had found proof for his view in comparative morphology as well as in the relative positions of the branches. He writes (loc. cit. p. 44) as follows: „Ich glaube, die Ansicht läßt sich auch noch weiter begründen durch einen Vergleich der Aeste in den verschiedenen Familien. Als ich von der nahe liegenden Meinung ausging, daß der Hauptast der Cypridiniden etc. homolog dem der Cypriden etc. sei, was meines Wissens bisher nirgends klar ausgesprochen, aber wohl als selbstverständlich angenommen worden ist, war ich überrascht durch den Mangel jedweder deutlichen morphologischen Beziehung zwischen den einzelnen Gliedern; mindestens fehlte jeder Anhalt dafür, wie eine Form aus der anderen, oder beide aus einer gemeinsamen Stammform abzuleiten seien. Anders, wenn wir den Nebenast der Halocypriden mit dem Hauptast der Cypriden vergleichen: hier finden wir als typische Gliederzahl 3, dort 4, die Anzahl der Glieder ist also nicht wesentlich verschieden, wenn sich auch nicht sicher nachweisen läßt, an welcher Stelle die Verschmelzung erfolgt ist (ich vermuthe, Glied 1 der Halocypriden ist homolog 1 + 2 der Cypriden). Wie bei den Halocypriden entspringt bei den Cypriden das letzte Glied am ventralen Rand des vorletzten, weit unterhalb der Spitze desselben, und die für die Halocypriden typische Zahl von 3 Borsten am letzten Glied wiederholt sich bei einer ganzen Anzahl von Cytheriden. Am überzeugendsten spricht für die hier vertretene Ansicht die Antenne der Polycopiden, bei denen wir 2 wohl entwickelte Aeste finden, den einen äußeren von auffälliger Uebereinstimmung mit dem Hauptast der Cypridiniden und Halocypriden, den anderen inneren zum mindesten mit deutlichen Beziehungen zu dem Hauptast der Cypriden etc., zum Nebenast der Halocypriden."

The weakness of this proof ought to be so striking to everyone who knows this group of animals in detail that any further discussion of it may even perhaps seem superfluous. But I shall criticize it briefly here. The small number of joints seems to be, as far as can be seen, the most important resemblance between the secondary branch of this antenna in the Cypridinids, Halocyprids and Polycopids on the one hand and the main branch of the Cyprids, Darwinulids, Nesideids and Cytherids on the other. In order to test the weight of the evidence afforded by the number of joints it ought to be sufficient to bring up the case of the family *Cytherellidae*: in this family the exopodite of the second antenna is characterized by two joints, its endopodite by three, i. e. in this family the exopodite

* In a „Berichtigung", on p. 80 of the mentioned work this author, however, writes as follows: „Wenn ich bei Besprechung des zweiten Antennenpaares dem langen geißelförmigen Ruderast die Bedeutung als Endopodit [illegible] und demgemäß den Nebenast mit seinen Sinnesschläuchen als den nach der Medialseite gerückten Exopoditen [illegible], so scheint mir diese Deutung doch nicht zutreffend zu sein. Ich glaube kaum zu irren, wenn ich [illegible] Geißelast als Exopoditen auffasse und den mehr medial gelegenen Nebenast als Endopoditen deute." In the later treatises by this author (1893, 1895) the endopodite is, however, still only termed the „Nebenast".

has fewer joints than the endopodite. With regard to the number of joints in the endopodite of the second antenna in different Ostracod groups I need only refer to what is written about this limb in the second chapter of this work. The weight of the evidence afforded by the position of the end joint of the inner branch is well illustrated by the fact that in the Halocyprids as well as in the Polycopids the end joint has a dorsal position, when the branch is pointing forwards contrary to the statement of G. W. MÜLLER (see my fig. 12 of *Halocypris brevirostris*). A close comparison between Halocyprids, Polycopids, Cyprids, Darwinulids, Nesideids and Cytherids will also afford good material as to the strength of the evidence of the number of the end bristles; it must be described as nil. There is no additional resemblance between the homologized branches, at least according to G. W. MÜLLER — and my own experience does not contradict this idea. The muscular system, for instance, shows, as anyone can easily ascertain, far-reaching differences in this limb in the different Ostracod groups. G. W. MÜLLER stated that he was surprised „durch den Mangel jedweder deutlichen morphologischen Beziehung zwischen den einzelnen Gliedern; mindestens fehlte jeder Anhalt dafür, wie eine Form aus der anderen, oder beide aus einer gemeinsamen Stammform abzuleiten seien" when using the old homologization. He might have experienced the same surprise on comparing the exopodite in, for instance, the Cypridinids and the Cytherellids. These are both essentially different from each other — but nevertheless it is certain that they must be homologous.

The fact that it is not possible to observe any far-reaching morphological agreement between the homologized branches of the Cypridinids, Halocyprids and Polycopids on the one hand and the other Ostracod groups on the other does not, however, render the homologization carried out by G. W. MÜLLER in any way less probable, as the morphological differences between the former groups and the latter are so far-reaching in other respects as well that no close agreement between these limbs can be expected a priori.

Mandible. Mandible: — This limb appears as a very uniform type in the different Ostracod groups. It has not been a subject for any important differences of opinion among preceding authors; we may note, however, that several of these authors have not given any opinion as to the morphological value of its different parts; thus the small appendage on the Cypridinid mandible, which is interpreted as the exopodite in this work, is often called simply „appendage". Apart from one important exception I have followed in this work the homologization used by G. W. MÜLLER in his work of 1894.

According to this writer the mandible, like the second antenna, is almost always developed as a biramous limb. The protopodite is powerful, and in most cases it is distinctly divided into two well developed joints, the coxale and the basale; in some Polycopids even three distinct protopodite joints are to be distinguished on this limb, see my fig. 5 of *Polycope setigera;* sometimes the protopodite is fitted with two powerful endites, one on the coxale and one on the basale (Halocyprids); in most cases, however, it has only one endite, which is situated on the coxale. The latter endite in, for instance, the Polycopids and Cyprids and most of the Cytherids is very powerful, but in the Cypridinids, on the other hand, it is weak and in most cases small and is not used as a masticatory organ; in a number of forms belonging

to this last-mentioned group this limb may even be without the slightest trace of endites, as, for instance, in the females of the genus *Sarsiella*. (For the endites on this limb in the males of the genus *Philomedes* see the description of this genus in the present work.) The endopodite is in most cases well developed and has well developed joints. The exopodite, on the other hand, is always more or less reduced and is unjointed. In the Cypridinids and the Polycopids the exopodite is situated at the typical place for that organ, dorso-distally-laterally on the basale, in the Halocyprids it is in most cases or perhaps always displaced somewhat medially. In the other groups, Cyprids, Darwinulids, Nesideids, Cytherids and Cytherellids, on the other hand, it is very much displaced proximally; in most cases it is situated near the proximal-lateral boundary of the basale. In most of the last-mentioned groups it is used for respiratory purposes, it has been developed as a vibratory plate.

The only point in the explanation given above as to which there seems to be the possibility of any justifiable doubt is whether the organ that has been explained as an exopodite in the Cyprids, Darwinulids, Nesideids, Cytherids and Cytherellids is really homologous with the exopodite. This has been generally assumed by preceding authors, but they have not given any reasons for this view of theirs.

This view seems to be supported by the fact that in the family *Polycopidae* the mandibular exopodite appears in two different types. One of these types resembles rather closely the one that is characteristic of the Cypridinids; cf. G. W. MÜLLER, 1894, pl. 7, fig. 7; the other shows a close agreement with the vibratory plate of the Cyprids, etc.; cf. G. W. MÜLLER 1894, pl. 7, fig. 39. That this process on the mandible of the Polycopids really corresponds to the exopodite is shown with all desirable distinctness first by its position and secondly by a comparison between the mandible and the maxilla in this family; cf. figs. in pl. 7, G. W. MÜLLER, 1894.

The following are the reasons why this opinion has nevertheless not been accepted in this work:

It is true that all Cyprids, Darwinulids, Nesideids, Cytherids and Cytherellids are, apart from the vibratory plate, quite without any appendage on the mandible that could be interpreted as an exopodite, and that in those forms of the Cypridinids and Polycopids that are furnished with a typical exopodite on the mandible there is no trace at all of any epipodial appendage on this limb. There is, however, one group, the Halocyprids, in which the second protopodite joint of this limb sometimes has two appendages, one situated disto-dorsally, somewhat medially, the other proximo-medially, at or somewhat above a point half-way up the joint. In the genus *Conchoecia* the former appendage is represented by a small, verruciform process with a plumous bristle; in the genera *Halocypris* and *Euconchoecia* * only by a plumous bristle, no traces of the verruciform appendage could be observed in these genera. In the genus *Thaumatocypris* there is at the corresponding place, according to G. W. MÜLLER's work of 1906 a, pl. VI, fig. 7, a curious-

* This is presumably also the case in the genus [illegible] but on account of lack of material I cannot give a definite opinion as to this.

little verruciform appendage, unjointed and without bristles. In my opinion this appendage corresponds to the exopodite of this limb. In the case of this appendage in the genus *Conchoecia* this explanation has already been adopted by preceding investigators; (G. W. MÜLLER, 1894, p. 49); in *Thaumatocypris*, on the contrary, this appendage is not even mentioned in our only description of this genus (G. W. MÜLLER, 1906 a). In most species of the genus *Conchoecia* the proximo-medial one of these appendages is represented by a small, verruciform process, which is furnished distally with a single bristle; in other species of this genus there is only a bristle developed at this place; in a few forms there is no trace at all of this appendage. In the species of the genus *Euconchoecia* that I had an opportunity to investigate this appendage was represented only by a bristle; no trace of any verruciform process could be observed. In *Halocypris* this appendage seems always to be quite absent. *Thaumatocypris*, which is in many respects the most primitive genus among the Halocyprids, is very interesting in this respect. In this genus there is at the corresponding place on the mandible „eine ovale Warze mit 2 Borsten an ihrem Vorderrand" (G. W. MÜLLER, 1906 a, p. 41). This appendage, which has not been observed by preceding investigators in the case of the genera *Conchoecia* and *Euconchoecia*, must certainly be regarded as an epipodial appendage. This assumption is supported by its position; that it can scarcely be homologous with the exopodite is shown, of course, by the fact that another appendage, presumably homologous with the exopodite, is found on this joint.

With regard to this appendage in the genus *Thaumatocypris* G. W. MÜLLER writes as follows, 1906 a, p. 42: „Bemerkenswert ist der warzenartige Anhang an der medialen Seite des 1. Tastergliedes. Einen Anhang trägt dieses Glied bei den Ostracoden ziemlich allgemein, aber deutlich lateral *(Podocopa)* oder dorsal (Mehrzahl der *Myodocopa*). Dieser Anhang wird als Außenast des Tasters gedeutet. Es kann kaum zweifelhaft sein, daß der hier beschriebene Anhang dem als Exopodit bezeichneten zum mindesten der *Myodocopa* homolog ist, doch widerspricht dieser Deutung die deutliche mediale Lage. Wahrscheinlich haben wir es hier mit einem auf die mediale Seite verschobenen Außenast zu thun, wenigstens scheint mir diese Deutung noch die einfachste und nächstliegende, sobald wir überhaupt eine Homologie dieses Anhangs und des sogenannten Exopodits bei den anderen Ostracoden annehmen."

For reasons given above I cannot accept the interpretation of this appendage as homologous to the exopodite in Cypridinids, Halocyprids and Polycopids. On the other hand it seems to me rather likely that it is homologous with the vibratory plate in Cyprids, Darwinulids, Nesideids, Cytherids and Cytherellids. The fact that this appendage is placed laterally in the five latter groups and medially in *Thaumatocypris* (and other Halocyprids) cannot, as G. W. MÜLLER has shown in the quotation given above, be considered any decisive argument against this homologization. (It is to be noted that the exopodite in the Halocyprids too is somewhat, though only slightly, displaced medially). If this line of argument is correct, the consequence of it would be that the vibratory plate on the mandible in Cyprids, Darwinulids, Nesideids, Cytherids and Cytherellids is not, as has been assumed by preceding authors,

homologous with the exopodite, but with an epipodial appendage, an explanation that is, by the way, also supported by the function of this organ.

On this, as on the following, limbs, the endites are numbered proximally distally.

M a x i l l a: The morphological interpretation of the different parts of this limb presents considerably greater difficulty than an explanation of the second antenna and the mandible, a fact that is clearly reflected in the preceding literature. A detailed study of the different types of maxillae in *Polycopidae* and a comparison between the state of affairs in this family and in other groups ought, however, to render possible a solution of this problem that, if not absolutely certain, is nevertheless fairly certain.

The maxilla of *Polycopsis serrata* G. W. MÜLLER (cf. G. W. MÜLLER, 1894, pl. 7, fig. 51 — reproduced in fig. III: 1 of the present treatise) represents the simplest type within the family *Polycopidae*; it may be described as a rather straight, typically biramous limb, presumably of a fairly primitive type. Its protopodite, which is fairly strong, consists of two well developed joints, coxale and basale, proximally of which there is a somewhat weaker joint, the procoxale. The exopodite and the endopodite, both of which are situated distally on the basale, the former weakly two-jointed, the latter distinctly threejointed, are also fairly well developed; the former is somewhat weaker than the latter. The protopodite has on the procoxale and the coxale slight indications of three endites armed with bristles; there are some ventral bristles on the basale as well. No epipodial appendage is developed. In other forms of this family, e. g. *Polycope rostrata* G. W. MÜLLER and *P. tuberosa* G. W. MÜLLER, the maxilla differs from the preceding type by having the basale, the endopodite and the exopodite bent ventrally and by an increase in the strength of the three endites on the procoxale and the coxale; the basale, on the other hand, has no endites. In both these species the exopodite shows no division into joints; in the former one the endopodite is still distinctly three-jointed, while in the latter this branch too is unjointed; in these species too, as in all the others belonging to this family, the maxilla has no epipodial appendage. Cf. G. W. MÜLLER, 1894, pl. 7, fig. 13 (reproduced in fig. III: 2 of this treatise) and fig. 27.

The maxilla found in the families *Cypridinidae* (in the scope given to this family in the present work) and *Sarsiellidae* (i. e. in all the C y p r i d i n i d s except the families *Rutidermatidae* and *Asteropidae*) shows a type that agrees rather strikingly with the maxilla of *Polycope rostrata* and *P. tuberosa* (see fig. III: 3). The morphological explanation of this limb in these families, which is given in the present work on the basis of a comparison with these two species may accordingly be considered as fairly well grounded. In these two families the protopodite of the maxilla is strongly developed and is more or less distinctly divided into joints; in most cases two well developed joints, coxale and basale, can be observed, proximally of which a third joint, the procoxale, is sometimes marked off. The procoxale and the coxale are (at least in all the species I have investigated or in which I was able to ascertain the conditions with the help of the literature — except in the genus *Pseudophilomedes*) armed with three endites; these endites are in most cases very strongly developed, considerably more strongly than in the two last-mentioned P o l y c o p i d s; the basale, on the other hand, has no trace of any endites. The basale has two appendages distally, which are certainly to be

identified with the exopodite and the endopodite. One of these is very powerful, with strong musculature, in most cases with two or three joints, and armed with numerous bristles, which are most frequently strong. The other is considerably less voluminous, even rather small in the sub-family *Philomedinae*, hyaline and weak, unjointed and only furnished with a few bristles; there are no muscles in this process, which is moved only by muscles attached at its base.

Fig. III. — Maxilla. 1. *Polycopsis serrata* G. W. Müller. 2. *Polycope rostrata* G. W. Müller. 3. Diagram of the sub-fam. *Cypridininae*. 4. Diagram of the genus *Asterope*. (From G. W. Müller, 1894; Nos. 3. and 4. are somewhat altered).

In all the species of the family *Cypridinidae* which were investigated by me and of which descriptions are given in this work, the latter appendage has only three bristles, all of which are placed near its distal end and which are almost always of the same type, rather long and weak, in most cases finely plumous, a uniformity that may perhaps be considered to indicate a great phylogenetic age. In the family *Sarsiellidae* this appendage seems, if one is to judge both from G. O. Sars's and G. W. Müller's drawings, to be still weaker than in the sub-family *Cypridininae*; among other things it always seems to be provided with only two distal bristles.

Which of these two appendages is to be looked upon as the exopodite and which as the endopodite? The fact that it is the exopodite that is most weakly developed in the family *Polycopidae* and that it is this branch that shows the greatest tendency to lose its division into joints in this family seems, at least to a certain extent, to make it probable that in the families *Cypridinidae* and *Sarsiellidae* it is the weak, unjointed appendage that represents the exopodite. We may in point of fact with a fair degree of certainty assume this to be the case; the relative position of the two appendages supports this explanation very decidedly, as the weak, unjointed process is in almost all the forms both of the family *Cypridinidae* (cf. G. O. SARS, 1887, pl. VII, fig. 11) and of *Sarsiellidae* (cf. G. O. SARS, 1887, pl. X, figs. 5, 6) placed at almost exactly the corresponding place on the basale as the mandibular exopodite in these forms, i. e. disto-laterally, laterally of the strong appendage; in most cases, perhaps, a very slight displacement ventrally can be observed (with this orientation the maxilla is thought of in its natural position, i. e. pointing obliquely forward and outward). Only in one out of all the forms seen by me, *Monopia (Cypridinodes) acuminata* (described in this work), in which, moreover, this appendage is rather strongly reduced, almost verruciform, is it placed distinctly medially of the larger process and, in addition, it is very much displaced distally. Only very slight importance, however, should be attached to this exception, as the maxilla in the sub-genus *Cypridinodes* must be regarded as very much metamorphosed. — Finally, if we start out from the fact that this explanation of the two distal appendages is correct, there cannot be much doubt that the lamelliform appendage, in most cases more or less rounded, that is found dorsally on the coxale in a number of forms belonging to the sub-family *Cypridininae* is to be explained as an epipodial appendage. In most cases this appendage has dense, fine hairs and, in addition, it is sometimes furnished with a few bristle-like processes; cf. C. CLAUS, 1873, pl. XI, fig. 27. Additional arguments in favour of this interpretation are perhaps, first, the fact that this appendage is developed rather late during the ontogeny and, secondly, that it is not very constant, being absent in a number of forms belonging to the sub-family *Cypridininae* and in the sub-family *Philomedinae* and the family *Sarsiellidae*; in the two latter groups it appears only in the form of „einen flachen, fein behaarten Hautsaum“ (G. W. MÜLLER, 1894, p. 56).

The maxilla in the family *Rutidermatidae* has about the same type as in the two preceding families; its exopodite seems, however, to be almost entirely reduced; cf. G. W. MÜLLER, 1908, pl. VII, fig. 5.

The morphological explanation of the different parts of the strange maxilla in the family *Asteropidae*, see fig. III: 4, certainly presents rather great difficulty, but nevertheless it can be carried out with fairly great certainty. Presumably this limb has originally had five or six joints, the protopodite having three and the endopodite two or three joints, thus having the same fundamental type as in the preceding families. The long, powerful, forward pointing part, situated distally of the endites, probably represents the distal joint of the protopodte, the basale; the part at which the endites issue thus corresponds to the procoxale and the coxale. It seems very probable that the two-jointed palp which is situated distally on the basale and points downward is, as in the preceding families, homo-

logous to the endopodite. The exopodite is possibly quite absent. It does not seem to be impossible, however, that the bristle or bristles found disto-laterally on the basale are to be explained as a remains of this branch. The large lamelliform appendage, furnished with fine hairs, that is found dorso-proximally on this limb in all the forms of this family known so far, is probably, on the other hand not homologous to the exopodite. It is presumably homologous to an epipodial appendage; this idea is supported both by the position of this appendage — distally on the part that has been explained as the coxale, i. e. at the same place as the epipodial appendage on the maxilla in a number of forms of the sub-family *Cypridininae* — and by its appearance, which bears a rather close resemblance to the epipodial appendage in the last-mentioned group.

Halocypridae

The Halocyprids have a maxilla that resembles very closely, on the whole, the type that is found in the family *Cypridinidae*; consequently in the present work quite the same homologization has been carried out in both these groups. The exopodite has, however, quite disappeared. C. CLAUS points out in his work of 1891 a, p. 26 the occurrence on the inside of the endopodite of „ein nach innen gerichteter borstentragender Fortsatz, dessen Deutung Schwierigkeiten bietet"; this process was homologized with the exopodite. This author is certainly mistaken as to this. A similar process with a single bristle is also found in Cypridinids; see, for instance, fig. 13 of *Philomedes* (*Scleroconcha*) *Appellöfi* below.* The epipodial appendage is always absent.**

Cypridae, Darwinulidae, Nesideidae and Cytheridae.

The explanation of this limb in the *Cypridae*, *Darwinulidae*, *Nesideidae* and *Cytheridae* seems, on the other hand, rather uncertain. The proximal part with its three endites of course probably corresponds, as in the preceding groups, to the procoxale and the coxale. But does the palp, as in Cypridinids, Halocyprids and Polycopids, correspond to the basale of the protopodite and the endopodite or does it represent the basale and the exopodite or only the endopodite or the exopodite? Is the vibratory plate to be considered as homologous to the exopodite or to an epipodial appendage? Neither the relative position of these organs, their morphology or their embryology give any certain information on these points. The fact that it is presumably the endopodite that has predominated in the development of the maxilla in Cypridinids, Halocyprids and Polycopids clearly does not justify us in assuming without further hesitation that the same branch has also predominated in the four families mentioned above; of this the second antenna affords proof. The fact that in the Cyprids, Darwinulids, Nesideids and Cytherids it is, in the case of the mandible, probably an epipodial appendage that is developed as a

* The same process had been already observed previously both by C. CLAUS, 1874 b, and by G. O. SARS, 1887 and G. W. MÜLLER, 1890 a. It is true that G. O. SARS did not directly state that this appendage was homologous with the exopodite, but nevertheless he points out (p. 75) that it „ifølge sin Beliggenhed aabenbart svarer til det nedadrettede membranøse Vedhaeng hos Cypridiniderne og den staerkt udviklede Vifteplade hos Podocoperne" (Translation: On account of its position it obviously corresponds to the downward pointing membranous appendage in the Cypridinids and the strongly developed vibratory plate in the *Podocopa*").

** G. S. BRADY, in his work of 1880, pl. XL, fig. 10 reproduces a maxilla of „*Halocypris atlantica* LUBBOCK" (presumably *Conchoecia serrulata* CLAUS) with a strongly developed vibratory plate, and he includes this character both in the family and the genus diagnosis. As G. O. SARS pointed out (1887, p. 75) it is presumably the vibratory plate on the fifth limb, which, owing to a mistake during the dissection, happened to be attached to the maxilla.

vibratory plate may certainly seem, at first sight, to support the assumption that we are also concerned with an epipodial appendage in the case of the maxilla in these groups. This argument will, however, count very little with those who take the same view with regard to the morphological value of the different parts of the limbs in *Protostraca* as that given above on p. 24. The situation and function of the vibratory plate support the assumption that we are concerned with an epipodial appendage; in the C y p r i d i n i d s, in addition, there is often, as we have seen above, an appendage which is situated at about the corresponding place on the maxilla and whose epipodial nature seems to be quite certain.

In short it seems to me at present quite impossible to find any more decisive proofs for the real morphological value of the different parts of the maxilla in the C y p r i d s, D a r w i n u l i d s, N e s i d e i d s and C y t h e r i d s. Under these circumstances would it not be best to accept the terminology used by the majority of the later writers on this subject? This would perhaps have been most correct. I have, however, allowed my personal opinion to prevail in this matter. The homologization adopted by me differs in one important point from that of previous authors: I take the vibratory plate on this limb too as an epipodial appendage. In accordance with the view taken by previous writers I look upon the distal part of this limb as an endopodite. It seems to be rather probable that this explanation is correct. At any rate the possibility that it is right must be considered as an open question.

Cytherellidae. In the case of the maxilla of the *Cytherellidae* too the difficulty of carrying out a certain homologization of the different parts is very great. The proximal part with its three endites may very well correspond to the two proximal joints of the protopodite, the procoxale and the coxale. There is the same uncertainty with regard to the palp and the vibratory plate as there is in the case of these organs in the C y p r i d s, D a r w i n u l i d s, N e s i d e i d s and C y t h e r i d s. It seemed to me most convenient to adopt the homologization accepted above for these four groups in the case of the first-mentioned group as well.

Historical. The explanation of the two appendages situated distally on the basale of the maxilla in the family *Cypridinidae* as an exopodite and an endopodite has already been made by C. CLAUS, 1865. This author writes concerning the exopodite (loc. cit. p. 151): „Jedoch geschieht hier“ (W. LILJEBORG, 1853) „des schmalen Anhanges keine Erwähnung, welcher bei unserer Art an der Spitze drei Borsten trägt und dem am ersten Maxillenpaare von *Cypris* und *Cythere* mächtig entwickelten ‚Kiemenanhang‘ zu entsprechen scheint.“ The vibratory plate, „Kiemenanhang“ on the maxilla of *Cypris* and *Cythere* is explained by this writer as an exopodite. C. CLAUS based this homologization especially on the important fact that in young larvae „noch im Brutraume des Mutterthieres“ these two appendages are developed more similarly (cf. C. CLAUS, 1865, p. 150, pl. X, fig. 6) and that it is only later on that the endopodite grows stronger in proportion to the „appendage“. A similar opinion is expressed by G. O. SARS, 1887; he identifies this process with the „saakaldte Branchialplade“* in the C y p r i d s and C y t h e r i d s; he does not, however, give any reasons in support of this view. On the other hand G. W. MÜLLER, in his work of 1890, has an explanation of this limb in the family *Cypridinidae* which differs exceedingly from that adopted in the present work. This writer describes the

* This writer expressed no opinion as to the morphological interpretation of this „Branchialplade“ [illegible]

basale as the first endopodite joint, the exopodite as an endite of the protopodite and the epipodial appendage as the exopodite; cf. loc. cit. p. 219. In his large monograph, 1894, G. W. MÜLLER retains this explanation on the whole, but, curiously enough, he does not touch at all on the question as to the morphological nature of the parts interpreted by me as the exopodite and the epipodial appendage.

The maxilla in the family *Asteropidae* has so far been explained as follows: According to C. CLAUS, 1876, p. 93, it can easily be traced back to the natatory limbs in Phyllopods and *Nebalia*: „nach Art eines Schwimmfußes gebaut", p. 94; the basale and the endopodite are explained as the endopodite, the epipodial appendage as an exopodite; the endites were observed and identified. G. O. SARS, 1887, p. 22 and G. W. MÜLLER, 1890, p. 220 and 1894, p. 56 adopted the same view as C. CLAUS.

With regard to the explanation of the proximal part of the maxilla with its endites in Cyprids, Darwinulids, Nesideids and Cytherids a somewhat different opinion from that adopted above has in some cases appeared in the literature. I shall not criticize these writers at any length, but merely quote what G. ALM says on this point (1915, p. 7): „Die 3 hier von mir als Kauladen gedeuteten Stammfortsätze sind auch anders aufgefaßt worden. ZENKER, v. DADAY, CLAUS und KAUFMANN haben nämlich behauptet, daß diese Fortsätze wirkliche Glieder sind, und zusammen mit dem kleinen, soeben als Endopodit aufgefaßten Teil den eigentlichen und dann aus 5 oder 4 Gliedern bestehenden Endopodit bilden. Als Stützpunkt für diese Auffassung gilt hauptsächlich das Vorhandensein kräftiger Chitinbalken zwischen den Basalteilen der Kauladen, auch haben einige Forscher geglaubt, besondere Muskeln für die verschiedenen Kauladen gefunden zu haben. Diese Muskeln dienen aber, wie JENSEN gezeigt hat, zur Bewegung der Atemplatte. In den Kauladen finden sich keine Muskeln, was dagegen in den Endopoditen der Fall ist, und dies bekundet ohne weiteres die Verschiedenheit zwischen den Endopoditen und den Kauladen. Auch sind die Chitinbalken nur im distalen Teil des Stammes vorhanden, und sind natürlich nur als Stützorgane der Kauladen aufzufassen."

5 h, 6th and 7th limbs.

Fifth, sixth and seventh limbs: — On account of the great resemblance between these appendages in many groups it seemed best to deal with them together.

These three limbs, like the maxilla, appear in rather different types in the different Ostracod groups, and an attempt to interpret their different parts morphologically seems to be even more difficult than the explanation of the maxilla. The difficulties in the solution of this problem are clearly shown in the preceding literature; even with regard to the main points we still find one unproved assumption opposed to another. I did not succeed either in attaining a quite certain solution of these problems, although I studied them very thoroughly. This uncertainty does not only apply to details; there still seem to be at least two almost completely different explanations possible.

I shall first try to give an account of these two explanations below; in this each limb will be discussed independently, and under each limb the explanations of previous authors will also be given. I shall then give the reasons that have caused me to choose one of these two methods of explanation. I may, however, point out here in passing that the result of this choice is only looked upon by me as provisory.

Fifth limb. The first method of explanation. Polycopidae.

Fifth limb: — According to the first of the methods of explanation just mentioned this limb would in my opinion be explained morphologically as follows:

Family *Polycopidae*: The fifth limb in this family is of a comparatively simple structure and it is possible that a thorough study of it — as in the case of the second antenna, the mandible and the maxilla — may contribute considerably to a correct explanation of the somewhat more complicated structure of this limb in other Ostracod groups. On the other hand, however, it is by no means impossible that this limb in the Polycopids is to be considered as a type that has been simplified in a number of respects; this is supported perhaps by the fact that the two following limbs in this group have been quite reduced; cf., in addition, chapter II of this treatise for the type of the fifth limb in the primitive Ostracods; in other respects it is perhaps of a type that is secondarily somewhat complicated.

According to G. W. MÜLLER the fifth limb of the Polycopids consists of „einem undeutlich gegliederten Stamm, der am Ende 2 kurze ungegliederte Fortsätze (Exopodit und Endopodit?) trägt“ (1894, p. 62). This opinion coincides with what I have called in this treatise the first method of explanation. According to this we thus see that this appendage too is to be considered as a biramous limb, although of a less marked type; it resembles rather closely the foliaceous type on account of the protopodite's strongly dominating over the verruciform, unjointed* branches, the exopodite and the endopodite, which are certainly well marked off, but very much reduced. The part which, according to this explanation, corresponds to the protopodite always seems to be divided into at least two joints; the proximal one of these joints is sometimes more or less distinctly two-jointed, i. e. three joints can be distinguished, which are consequently to be denoted as the procoxale, coxale and basale. This limb is furnished proximally with a rather long and narrow vibratory plate, which is furnished with fairly numerous and long marginal bristles; this plate is united throughout its whole length with the outside of the two joints that were termed above the procoxale and the coxale; cf. fig. IV: 1 of *Polycope frequens* G. W. MÜLLER. — In *Polycopsis serrata* G. W. MÜLLER the vibratory plate issues, according to G. W. MÜLLER, 1894, pl. 7, fig. 37, from a narrow base situated proximo-laterally on the joint denoted above as the procoxale, but it seems to me not at all impossible that this organ is, in this form too, attached throughout its whole length to the two proximal joints of the protopodite and that in the specimen investigated by G. W. MÜLLER (presumably only one specimen was investigated by this writer; cf. his work of 1894, p. 239) it was partly detached, during preparation, from the protopodite along the chitinous list that forms its inner boundary. — If the two distal verruciform processes on this limb are to be considered as the exopodite and the endopodite, then it is evident that this vibratory plate must be explained as an epipodial appendage, as G. W. MÜLLER has also done. Of the two distal processes the outer one is to be denoted as the exopodite, the inner one — armed with only one bristle in the accompanying figure — as the endopodite. This limb has no endites.

Family *Sarsiellidae*: The fifth limb in this family shows a rather close resemblance to that which is found in the family *Polycopidae*. (It seems to be rather difficult to decide for

* Sometimes a more or less slight indication of a division into two parts can be observed [illegible]

certain whether it is to be considered, compared with the fifth limb in the following family, as a primitively simple one or as having been simplified secondarily; for several reasons the latter of these two alternatives seems to me the more probable; with regard to this I shall only refer to what has been written below in the second chapter of this treatise about the type of the fifth limb in the primitive Ostracods.) The exopodite, endopodite and epipodial appendage on this limb are — if this same method of explanation is employed for this family as has just been used for the family *Polycopidae* — of types that differ rather slightly from those observed in the *Polycopidae*. The process that is supposed to represent the exopodite is, however, relatively larger, the endopodite* is small relatively; the joints of the protopodite cannot be distinguished. There is, at least in some cases, an indication of an endite proximally of the process that has been explained as the endopodite (cf. the fifth limb of *Sarsiella capsula* A. M. NORMAN, in G. O. SARS, 1887, pl. X, fig. 8, reproduced below, fig. IV: 2 and G. W. MÜLLER 1894, pl. 4, fig. 28).

Family *Cypridinidae* (see fig. IV: 3, 4): In this family the fifth limb is both very much differentiated and (secondarily?) also of a rather marked foliaceous type. But in spite of its complex structure it shows a fairly great resemblance to the same limb in the families *Polycopidae* and *Sarsiellidae*, especially to the latter. If the homologization carried out above is applied to this family, we have, in my opinion, the following results: The protopodite is powerful and often dominates somewhat over the distal part of the limb; it is in most cases divided into two joints, but sometimes, however, it is three-jointed, the proximal one of these two joints has been divided into two more or less distinct joints; in the latter case we can thus distinguish a procoxale, a coxale and a basale. The protopodite is armed on its inner edge with three endites, in most cases powerful, one on the procoxale, one on the coxale and one on the basale. According to this method of explanation the part situated distally of the protopodite is homologous with the exopodite; it is in most cases four- or five-jointed (four-jointed in the accompanying figure). Of the joints of the exopodite the two proximal ones are in most cases very strongly chitinized; each of them has on the inner edge a powerful endite armed with bristles and teeth. The following joints differ in most cases very considerably from the preceding ones on account of their structure**; they are very slightly chitinized and their bristles are in most cases rather soft and plumous. The fourth exopodite joint is, as G. W. MÜLLER showed as early as 1894, p. 62, sunk deeply in joint no. 3. In this way the latter joint is divided into two lobes, one outer and one inner one; the inner lobe is, in addition, often more or less reduced. The vibratory plate, which, according to this explanation, is to be looked upon as an epipodial appendage, has almost exactly the same type and position as the same organ in the family *Sarsiellidae*. The endopodite seems to be always absent in this limb.**

Family *Asteropidae*: In this family the fifth limb shows, as we know, a type that differs very much from the same appendage in other families; cf. the genus description of *Asterope*

* The interpretation of this part seems to me, however, rather uncertain.

** This difference caused me at first to assume that the two powerful proximal joints represented the endopodite, an assumption that seemed to be supported by fig. 4, p. 60, G. W. MÜLLER, 1894 (= my fig. IV: 3). It is, however, presumably incorrect.

below. C. CLAUS wrote in 1876, p. 94, of this limb that it „seine fußähnliche Form erhalten hat". If by this statement C. CLAUS meant that this limb had retained a number of primitive characteristics, he has certainly committed a fundamental mistake. This limb is undoubtedly

Fig. IV. — The fifth limb: according to „the first method of explanation". 1. *Polycope* [illegible] G. O. [illegible] 2. *Sarsiella capsula* A. M. NORMAN. 3. *Cypridina mediterranea* O. COSTA, juvenis, from [illegible] 4. The same [illegible] before. 5. *Asterope oblonga* GRUBE. 6. *Conchoecia*. 7. *Macrocypris*. 8. *Cythereis* [illegible] G. W. MÜLLER. [illegible] 3, 4, 6 and 8 from G. W. MÜLLER, 1894; figs. 3, 4 and 6 are somewhat modified. Figs. 2 and [illegible] from G. O. SARS, [illegible] no. 5 is somewhat modified. Fig. 7 is drawn by me from nature.

to be regarded as very much modified. This far-reaching modification and the total lack of known transitional forms makes any attempt at homologization merely a caprice, at worst obviously incorrect, at best unverifiable.

As an instance of an homologization of the former kind the following may be given: In 1876, p. 94 C. CLAUS explained the spine-like ventral part of the chitinous support of the vibratory plate, the part that, as it were, completes posteriorly the part of this limb that is called „the comb" in this work, as „Kieferhaken, der eine Beziehung zur Nahrungsaufnahme zu besitzen scheint". The complete incorrectness of this explanation is shown with all desirable distinctness by the fact that this chitinous part is not free, but only consists of a thickened part of the wall of the body, and that a similar spine-like part also completes the vibratory plate or perhaps, more correctly, the chitinous support of this organ dorsally. (It may be pointed out that in forms whose fifth limb seems to represent a more primitive type, e.g. in the sub-family *Cypridininae*, the vibratory plate of this limb is often completed ventrally by a chitinous process. This process is, however, probably not homologous with the chitinous part discussed above in the *Asteropidae*.)

Only two out of all the preceding authors have tried to homologize the part of this limb that is called „the comb" in the present work.

One of these writers, C. CLAUS, 1876, p. 94 and 1888, p. 152 explained this organ as an endopodite; transcribed in the terminology used by me above this would correspond to about the whole exopodite. C. CLAUS did not give any further reasons for his view; it is to be pointed out that he considered the vibratory plate to be homologous to the exopodite.

The only writer who has made a more thorough attempt to homologize this organ is G. W. MÜLLER, who has dealt with this problem on two separate occasions, 1890, p. 221 and 1894, p. 63.

In the first-mentioned place we read as follows: „Die größte Schwierigkeit bietet beim Versuch, einen Vergleich durchzuführen, *Asterope*; augenscheinlich handelt es sich auch hier um eine weitgehende Reduction; der eigenthümliche Kaufortsatz von *Asterope* dürfte nur einem der Glieder von *Cypridina* entsprechen, zum mindesten der weit vorragende Theil, wenn es auch nicht ausgeschlossen erscheint, daß in den vorderen Theil des borstentragenden Randes die Reste von anderen Gliedern mit aufgegangen sind. Ziehen wir zum Vergleich die Bildung beim Männchen von *Philomedes* heran, so können wir, die Berechtigung eines solchen Vergleichs vorausgesetzt, kaum daran zweifeln, daß es der Fortsatz 7 ist, aus dem der eigenthümliche Kaufortsatz bei *Asterope* hervorgegangen. Der Fortsatz beim Männchen von *Philomedes* hat die entsprechende Lage, zeigt auch bereits die eigenthümliche Richtung. Ziemlich häufig entspringt mitten auf dem Fortsatz von *Asterope* eine einzelne, ziemlich lange Borste; an ihrer Stelle finden wir bei *Asterope hilgendorfii* zwei längere Borsten, die auf einem kleinen, aber immerhin deutlich abgesetzten Grundglied entspringen, welches durch einen schmalen Fortsatz mit dem gemeinsamen Stamm verbunden ist. Dieser kurze Fortsatz, ebenso wie die gewöhnlich allein vorhandene Borste, muß seiner Lage nach dem Fortsatz 8 an der zweiten Maxille von *Cypridina* entsprechen" (cf. G. W. MÜLLER, 1890, pl. XXVI, fig. 4). The joint of the fifth limb that is denoted by G. W. MÜLLER as no. 7 corresponds to the joint that was denoted as the fourth exopodite joint in the homologization carried out by me above for the family *Cypridinidae*; the joint denoted by G. W. MÜLLER as no. 8 corresponds to the outer lobe of the third joint of the exopodite according to my terminology. Thus, according to the statement just quoted from G. W. MÜLLER,

the comb as a whole or at least the greater part of it is homologous to the joint that is denoted by me above as the fourth exopodite joint; the long bristle (or the two long bristles) on the lateral side of the comb is, according to the same statement, part of the outer lobe of the joint that is termed by me the third exopodite joint.

After having had an opportunity of studying the fifth limb of the genus *Pseudophilomedes* G. W. MÜLLER, however, altered his opinion. Thus he writes, 1894, p. 63: „Ueber die Morphologie des Fortsatzes habe ich an anderem Ort die Ansicht geäußert, daß er vielleicht homolog dem Glied 4 sei, wobei ich mich auf die Aehnlichkeit mit der 2. Maxille der ♂ von *Philomedes* stützte; hier sehen wir das 4. Glied nach vorn gerichtet. Die einzelne Borste, welche auf dem äußeren Rand des Blattes entspringt, ... sollte den hinteren Borsten von Glied 3 entsprechen. Zu einem anderen Vergleich giebt *Pseudophilomedes* die Veranlassung. Der Fortsatz entspricht in Richtung und Lage dem stark verlängerten Zahnfortsatz von *Pseudophilomedes*; der Haken an der Basis würde dann dem inneren (vorderen) Zahn, die Borste dem Glied 4 entsprechen. Die Aehnlichkeit in der wechselseitigen Lage der einzelnen Theile ist auffällig genug. Giebt man die Möglichkeit zu, daß sich ein Zahn in einen borstentragenden Fortsatz umwandelt, so erscheint dieser Vergleich zutreffender als der ältere. Einstweilen muß wohl die Frage in Ermangelung entscheidender Zwischenformen als offen betrachtet werden" (cf. G. W. MÜLLER, 1894, p. 60, fig. 6). In the statement just quoted joint no. 4 corresponds to joint no. 7 in the statement of 1890; joint no. 8 in the statement of 1890 corresponds to the outer lobe on joint no. 3 in the statement of 1894. The „Zahnfortsatz" corresponds to the second joint on the part of this limb in the *Cypridinidae* that was termed the exopodite in the homologization that I carried out above for this family. Joint no. 4 in the statement just quoted corresponds to the joint that, according to the terminology used by me above, is denoted as the fourth joint of the exopodite. According to G. W. MÜLLER's last statement the comb is thus to be considered as homologous to the second joint of the part that is termed by me above as the exopodite, the long bristle (or the two long bristles) on the outer side of the comb is, according to the same statement, part of the joint termed by me the fourth exopodite joint.

The fact that G. W. MÜLLER writes: „Giebt man die Möglichkeit zu, daß sich ein Zahn in einen borstentragenden Fortsatz umwandelt" seems to indicate that this author has started from the assumption that the primitive forms of the family *Asteropidae* were characterized by a fifth limb of about the same type as in the genus *Pseudophilomedes*. This can, however, scarcely have been the case. Although, as has been shown in another part of this treatise, of all the recent forms so far known the sub-family *Philomedinae* is probably most closely related to *Asteropidae*, the latter can by no means be considered as being derived directly from the former. On the contrary, the sub-family *Philomedinae* must certainly be considered to have a type that differs very much from the primitive form from which the Asteropids originate; the fifth limb especially must be considered as being rather much modified in this sub-family. On the other hand it does not seem impossible that *Philomedinae* and *Asteropidae* originate from a common primitive form. The part of the fifth limb that was termed the first and second exopodite joints in the homologization carried out by me above was presumably more primi-

fully developed in this primitive form than in the sub-family *Cypridininae* and, as in the latter, it was armed with numerous bristles.

Which of the explanations described above, C. CLAUS's, G. W. MÜLLER's of 1890 and that of the same investigator of 1894 is to be considered correct — judging from the view of the method of homologization applied by me above to the families *Polycopidae*, *Sarsiellidae* and *Cypridinidae*? Or is it possible — judging from this point of view — that any of them on the whole is to be considered quite correct?

No very definite answer to these questions can be given — at least at present. The strongly modified type of this limb and the complete absence of any known intermediate forms seem — as has been shown above and as G. W. MÜLLER has also previously pointed out — to make it almost impossible to carry out a certain homologization of this organ at the present time.

It seems to me very improbable that, as G. W. MÜLLER assumed in 1894, the comb has developed only from the part denoted above as the second joint of the exopodite, on account of the fact that this organ issues near the base of the limb. The same reason militates to an even greater extent against G. W. MÜLLER's assumption of 1890. It seems to me most probable that the proximal part of the comb has been formed by what I termed above the protopodite, its distal part by what is called above the first and second joints of the exopodite. The long bristle (or the two long bristles) with the short bristles situated near it (them) on the lateral side of the comb presumably belong, according to my idea, to what I have called the third and fourth exopodite joints; on the other hand it seems quite impossible to decide whether they belong to only one of or to both these joints. It is uncertain, however, whether this homologization is more correct than that worked out by G. W. MÜLLER. It is at present based only on such weak arguments as the relative positions of the different parts.

The vibratory plate on this limb is of about the same type as in the families *Polycopidae*, *Sarsiellidae* and *Cypridinidae* and must certainly be homologized with this organ in these families. According to the explanation given above it is consequently to be considered as an epipodial appendage. Cf. the adjoining figure IV: 3, 4.

Family *Halocypridae*: At the first glance there seems to be a great gap between the type of the fifth limb in the families *Sarsiellidae* and *Cypridinidae* and that found in the same organ in the family *Halocypridae*. While in the two first-mentioned families this appendage is developed as a more or less typical foliaceous limb, in *Halocypridae* it is a typical rod-shaped limb. Still it is possible to show, although with a certain amount of doubt, which parts of this limb are homologous in these three families.

If the homologization employed above is applied to the fifth limb of the H a l o c y p r i d s we shall find the following results: The vibratory plate is to be considered as homologous to the same organ in the preceding families and is consequently to be denoted as an epipodial appendage. The three distal joints are probably to be homologized with the process that is denoted by me above as the exopodite. The protopodite, which is proportionately almost as large as in, for instance, the *Cypridinidae*, is sometimes divided into two joints, which are often only weakly marked off from each other, a proximal one, on which the vibratory plate issues which is to be considered as a procoxale and a coxale, and a distal

one, which, like the preceding joint, is rather powerful and is to be denoted as a basale. Distally on the anterior side the protopodite has indications of two endites. Distally of these and in front of the part that has just been termed the exopodite there is a rather strong, but short and unjointed, process, furnished with powerful muscles and bristles, a process which, on account of its position, is perhaps to be regarded as homologous to the process in the family *Polycopidae* that was termed by me above the endopodite; cf. fig. IV: 6. The morphological value of this last part seems to me, however, rather doubtful. Does it perhaps belong to the protopodite or the exopodite?

Cypridae, Darwinulidae, Nesideidae, Cytheridae and Cytherellidae.

The families *Cypridae, Darwinulidae, Nesideidae, Cytheridae* and *Cytherellidae*: In these families the fifth limb shows such far-reaching agreement with the same limb in the *Halocypridae* that one can show with a fair degree of certainty which parts of this appendage in these families correspond to the different parts of the same organ in the last-mentioned group.

Fig. V. — Position of the vibratory plate on the fifth and sixth limbs. 1. Fifth limb of *Sclerochilus contortus* (A. M. Norman) ♂. 2. Sixth limb of *Nesidea frequens* (G. W. Mueller) (From G. W. Mueller, 1894).

The vibratory plate, which is more or less completely reduced in the Cytherids and a number of Cyprids, is certainly homologous with the same organ in the Halocyprids and, according to the explanation made use of above, it is consequently to be denoted as an epipodial appendage. It is situated at different places on the protopodite, sometimes distally*, sometimes proximally (cf. the accompanying fig. V: 1). The protopodite is unjointed. Distally anteriorly it has sometimes an unjointed process pointing forwards and inwards, which, according to its position, is to be considered homologous to the part that was denoted as the endopodite in the preceding family. This part is in most cases more or less completely absent in *Nesideidae* and *Cytheridae*. The backward pointing, rod-shaped

* The single bristle on the posterior side of the protopodite of this limb in some Cyprids (see fig. IV) has certainly been explained by me as a reduced form of the vibratory plate, but this assumption is, however, far from certain. This uncertainty is perhaps best illustrated by the sixth limb of *Cytherella* ♀; on this we find on the posterior side of the protopodite not only a well-developed vibratory plate, but also some single bristles. Cf., for instance, *C. sordida*, G. W. Mueller, 1894, pl. 32, fig. 5.

one- to four-jointed part of this limb seems to be homologous with the branch that was termed the exopodite in the preceding families. Cf. figs. IV: 7, 8.

Second method of explanation.

According to the second of the two methods of explanation mentioned above the fifth limb in the different families is in my opinion to be explained as follows:

The vibratory plate corresponds to the exopodite. The greatest difficulty in carrying out this homologization arises when we have to define the boundary between the protopodite and the endopodite. In this but rather little value can be attached to the position of the vibratory plate; it is very far from improbable that this organ has been subject to not inconsiderable alterations in position. The difficulty in fixing this boundary was really so great that it seemed to me impossible to reach any definite result; there have always seemed to be different possibilities present.

Polycopidae.

Family *Polycopidae*: The protopodite either has the same extension as it has according to the first method of explanation, i. e. it is more or less distinctly three-jointed, with a procoxale, a coxale and a basale, or else it is formed only by the two joints on which the vibratory plate is fixed. In the first case the nearest joint distally to the vibratory plate would correspond to the basale and the outer of the two distal processes would correspond to the endopodite, the inner being an accessory appendage, an endite on the basale, cf. fig. VI; in the second case the first-mentioned joint would correspond to the first endopodite joint and one of the two distal processes is to be regarded as the end joint of the endopodite, the other as an accessory appendage to the first endopodite joint. In the former case the vibratory plate, the exopodite, has been displaced proximally, but not in the second case.

Sarsiellidae.

Family *Sarsiellidae*: As is seen above, this limb is almost entirely without any division into joints. The large outer distal process is to be regarded as an endopodite, the small inner distal lobe presumably as an endite either on the basale (cf. the accompanying figure VI) or on the endopodite.

Cypridinidae.

Family *Cypridinidae*: The protopodite either has the same extension as according to the first method of explanation or else it is represented only by the joint (or the two joints) on which the vibratory plate is fixed. In the former case the joint nearest to the vibratory plate distally is to be homologized with the basale, and the following joints correspond to the endopodite; with this homologization the part that was denoted, according to the first method of explanation, as the first and second exopodite joints would correspond to the first and second joints of the endopodite; cf. the accompanying figure VI. In the latter case the joint situated distally nearest to the vibratory plate is to be considered as the first endopodite joint; the endopodite should have five joints in the accompanying figure. In the former case the exopodite has been displaced proximally.

Asteropidae.

Family *Asteropidae*: The comb seems to have been formed from the protopodite + the two proximal endopodite joints or from the protopodite and the three proximal endopodite joints. The long bristle (or the two long bristles) with the short bristles close to it (or them) on the lateral side of the comb appears, according to this interpretation, to belong to the two distal joints of the endopodite or to one of these two joints; cf. the accompanying figure VI.

The families *Halocypridae, Cypridae, Darwinulidae, Nesideidae, Cytheridae* and *Cytherellidae*: The protopodite either has the same extension as according to the previous explanation, with the addition, however, that even the part that was denoted as the endopodite according to this explanation belongs to it; this part is to be considered as an endite on the basale; cf. *Halocypridae, Cypridae, Darwinulidae, Nesideidae, Cytheridae*

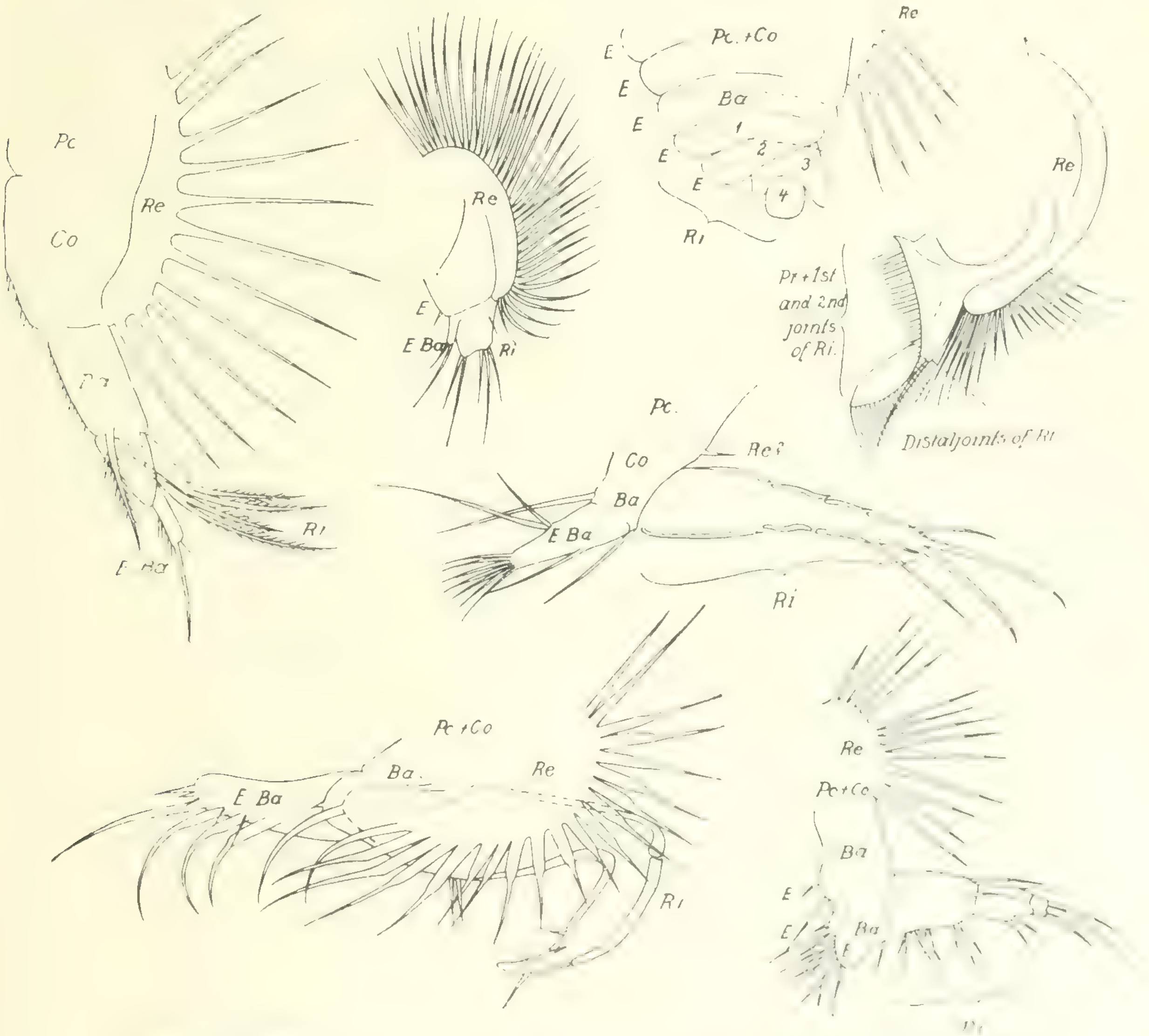

Fig. VI. — The fifth limb, according to „the second method of explanation", one [illegible]. For further explanation, see fig. IV.

the accompanying figures VI or else the joint situated distally nearest to the vibratory plate is to be homologized with the first endopodite joint, equipped with an endite process. In the former case the backward pointing branch would represent the whole endopodite, in the latter case only the second, third and fourth endopodite joints. In the former case the vibratory plate has been displaced proximally.

The boundary between the protopodite and the endopodite may of course be thought of as being drawn in other ways as well; the alternatives described above seem, however, to be those that are most probable. As I have already pointed out above, I have not succeeded in deciding which of these two alternatives have the strongest arguments to support them; I know of no forms so far that give any clear evidence on this point.

Most of the authors who have dealt with this group of *Crustacea* are very superficial with regard to this important problem. Thus, for instance, no one has tried so far to identify the different joints of the protopodite; the terms procoxale, coxale and basale have not come into use for this group.

The vibratory plate has — if its morphological value has been touched upon at all — been taken by most investigators to be the exopodite, and the distal part of this limb, which often points backwards, has been taken an endopodite. With regard to the exact boundary between the protopodite and the endopodite these writers are very vague, and one cannot find any definite statements in their works on this point; most of them seem, however, to have taken the forward pointing processes on the antero-ventral part of this limb as belonging to the protopodite.

The only one of the previous authors who has sought to enter more deeply into this difficult problem is G. W. MÜLLER. Leaving aside the opinion of this writer as expressed in earlier works — which seems to me of little interest in this connection — I shall give an account here of his view as expressed in his monumental work of 1894, a view that he did not depart from in his later works. According to this investigator the vibratory plate on this limb is to be taken as an epipodial appendage in all families, ,,ohne damit eine Homologie mit dem Epipodialanhang der *Phyllopoda* behaupten zu wollen, wie mir überhaupt die Homologie der verschiedenen Epipodialanhänge keineswegs sichergestellt erscheint" (G. W. MÜLLER, 1894, p. 85). The family *Polycopidae*: With regard to the fifth limb of this family G. W. MÜLLER — the only investigator who has dealt in detail with the homologization of this appendage — gave, as is seen above, p. 37, on the whole the same explanation as I have worked out above and called the first method of explanation. This author does not, however, touch upon the question as to which of the two distal verrucae corresponds to the exopodite and which to the endopodite. The family *Sarsiellidae*: The large outer distal process corresponds to ,,den verschmolzenen beiden letzten Gliedern" (1894, p. 63) of the endopodite; no information is found in this author's works as to the morphological value of the small inner distal process. The family *Cypridinidae*: The joint or the two joints on which the vibratory plate is fixed was identified by G. W. MÜLLER with the protopodite; all the following joints were homologized with the endopodite; the part that, according to the first of the two methods of explanation given by me above, is homologous with the first and second joint of the exopodite, is taken to be a single divided (bifurcated) joint, the second joint of the endopodite. The family *Asteropidae*: G. W. MÜLLER's idea of the morphology of this limb has already been described above, so that I need only refer to this account, p. 41 above. The family *Halocypridae*: The backward pointing branch is taken by this writer as the second, third and fourth endopodite joints; the part that, according to the first of the two methods of homologization given by me above, was interpreted as the endopodite,

is taken to be the first endopodite joint. The families *Cypridae*, *Darwinulidae*, *Nesideidae*, *Cytheridae* and *Cytherellidae*: The backward pointing branch is taken as the endopodite, but G. W. MÜLLER did not feel quite certain about this explanation, cf. below; this uncertainty is also expressed in his work of 1912; in the latter work we read on p. 105 „der hintere Ast, den ich als Endopodit bezeichne (obwohl die Deutung nicht sicher)“ . . .; the forward pointing process is homologized with the exopodite.

Sixth limb.

S i x t h l i m b: — Like the following limb this is, as we know, quite absent in the family *Polycopidae*, so that in this case, as in the case of the second antenna, the mandible and the maxilla, this family cannot throw any light on the conditions in the other groups.

Halocypridae, Cypridae, Darwinulidae, Nesideidae, Cytheridae and Cytherellidae.

The families *Halocypridae*, *Cypridae*, *Darwinulidae*, *Nesideidae*, *Cytheridae* and *Cytherellidae*: In these families the sixth limb shows such far-reaching agreement with the fifth limb that there seems to me to be no serious reasons against carrying out quite the same homologization for both these appendages. In other words there seem to be for the sixth limb, as for the fifth one, two quite different explanations possible. According to the first of these two methods of explanation the vibratory plate is to be taken as an epipodial appendage, and the backward pointing rod-shaped branch as the exopodite. The endopodite is scarcely ever developed; only in the *Halocypridae* is there often a part (without any endite) that must be homologized with the part that has been explained as the endopodite on the fifth limb; cf. p. 43 above and fig. 30 of *Conchoecia symmetrica* G. W. MÜLLER, in this treatise below. According to the second method of explanation the vibratory plate is homologous with the exopodite, the backward pointing rod-shaped branch with the endopodite. The vibratory plate is well developed only in H a l o c y p r i d s and C y t h e r e l l i d s; in all the others it is more or less completely reduced. There are no endites.

It seems to me that it is somewhat more difficult to explain this limb in the C y p r i d i n i d s. In all the forms of this group it is, as we know, developed as a broad, flattened appendage. In the families *Sarsiellidae* and *Asteropidae* it lacks — presumably secondarily — entirely or almost entirely all traces of division into joints and, in other respects as well — this is especially the case in the *Sarsiellidae* — it is very slightly differentiated. It is, of course, quite impossible to carry out a detailed homologization in these two families. The family *Cypridinidae*: In this family the structure of the sixth limb is more complicated; in most cases it has well developed joints; the variation in the structure of this limb is, however, rather slight in this group. According to the first method of explanation the proximal joint of this limb, which is almost always characterized, as shown, for instance, in the accompanying figure, by two bristle-bearing endites on the anterior edge, is presumably to be regarded as a procoxale and a coxale, the following joint, which also has a powerful endite on the anterior edge, appears to correspond to the basale; the two following joints, the proximal one of which is relatively short and is armed on the anterior edge with a powerful endite, while the distal one is comparatively large and has no endite, correspond to the exopodite; the collection of short bristles, which sometimes issues on a lobe-like little process almost always found on the posterior edge of the protopodite, is, according to this method of explanation to be considered as the remains of an epipodial appendage; cf. the accompanying figure VII: 1.

According to the second method of explanation the last-mentioned collection of bristles is to be considered as a remains of the exopodite, the two distal joints presumably represent the endopodite; the protopodite has the same extension as according to the former method of explanation; cf. fig. VII: 2.

The collection of bristles that is in most cases to be found on the posterior edge of the part that has been explained as a protopodite is thus, in my opinion, to be considered as the rudiment of a homologon to the vibratory plate on the preceding limb. This assumption seems to be supported both by the position of these bristles and by the fact that they are sometimes

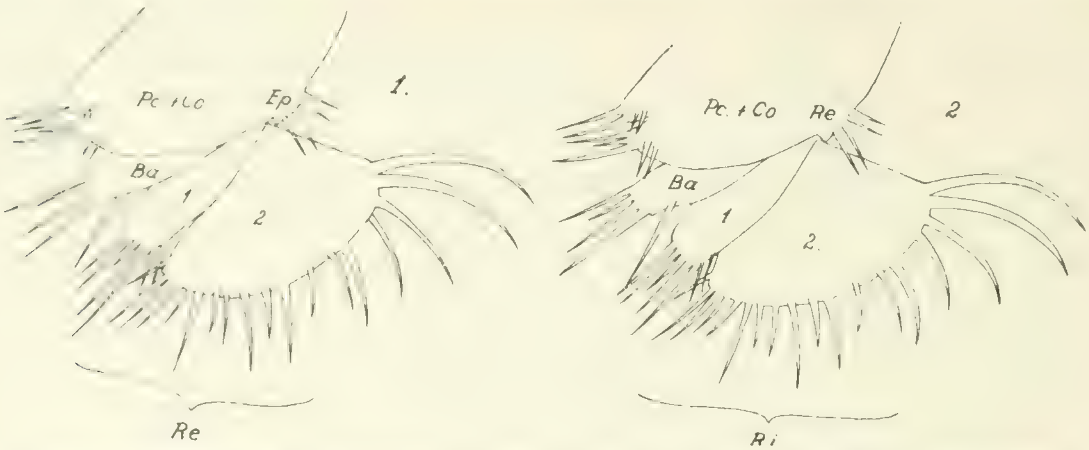

Fig. VII. Sixth limb of *Cypridina mediterranea* O. Costa (From G. W. Müller, 1894). 1. According to „the first method of explanation". 2. According to „the second method of explanation" the first alternative.

attached to a lobe-like process, though the latter is small. It seems, at least at present, to be impossible to prove this assumption. For the cause of a possible reduction of this vibratory plate see G. W. Müller, 1894, p. 198.

There is no part that might be explained as an endopodite according to the first method of explanation* (as in the fifth limb).

We must note the uncertainty that, in my opinion, exists in both the methods of explanation described above, with regard to the boundary between the protopodite and the branch situated distally of this. Perhaps only the proximal joint, the one that in most cases is characterized by having two bristle-bearing endites on the anterior edge, is to be considered as a protopodite. Or does the exopodite (or the endopodite as the case may be) consist only of the large end joint? These are questions that probably cannot be decided with certainty, at least at present. Of the three alternatives mentioned above it seems to me, however, that the first, namely that the protopodite comprises the two proximal joints, is the most probable and it has been adopted in the present work. This statement is supported, it seems to me, by a comparison between the fifth and sixth limbs. It may be sufficient to refer to a comparison between the schematic figures, reproduced above, of the fifth limb in the sub-family *Cypridininae* (figs. IV: 3, 4) and the figures,

* It seems to me improbable that it is represented by the joint next to the outer one. Cf. the embryology of the limb below.

reproduced here, of the sixth limb in the same group. From this comparison it will be seen that, in spite of profound differences, these two limbs have the same fundamental plan; it seems to me that the homologization of the different parts of one limb stands or falls according to the homologization of those of the other. The great resemblance that exists between the fifth and sixth limbs in the families *Halocypridae*, *Cypridae*, *Darwinulidae*, *Nesideidae* and *Cytheridae* seems to justify us in drawing conclusions in the family *Cypridinidae* as well from a comparison between these two limbs.

This limb begins embryologically as a simple, unjointed, lamelliform process; in the next larval stage it is two-lobed distally, with one rather large outer lobe, the end joint of the complete limb and a smaller inner lobe, explained according to the interpretations given above as the first joint of the exopodite (or the endopodite respectively). It is only later that the proximal joints with their endites appear. Cf. G. W. MÜLLER, 1894, pl. 34, figs. 21, 22 and 24. Whether these embryological facts justify us in drawing any final conclusions in the questions dealt with above I must leave unsettled.

Historical. In dealing with the morphology of this limb, just as in the case of the others, the preceding writers have been rather superficial; most of them do not seem even to have tried to form any idea as to the morphological value of the different parts of this appendage. We find the following views in the previous literature: C. CLAUS, 1865, p. 151, seems to have had a vague idea that the part of this limb in *Cypridinidae* that has been explained by me above as the end joint corresponds to the vibratory plate on the preceding limb; he expresses himself so cautiously, however, that one cannot be quite certain about this — „welcher seiner Lage nach an die schwingende Platte des vorhergehenden Kiefers erinnert". C. CLAUS himself, however, took up a definite position against this assumption as early as in his work of 1873 and this idea does not seem to have been seriously adopted by any of the other writers either.* In the work just mentioned C. CLAUS writes as follows of this joint (p. 218): „In der That erinnert die Stellung und Form dieser mehr oder minder dreieckigen Platte an den sog. Maxillarfuß von *Cypris*, sowie an das diesem gleichwerthige vordere Beinpaar von *Halocypris*, ohne jedoch morphologisch diesem (5.) Gliedmaßenpaar zu entsprechen." The small collection

* It is true that G. O. SARS in his work of 1887, p. 9 seems to adopt this explanation, as he writes as follows: „Laminarum vibratoriarum 2 paria adsunt valde dissimilia, anteriores de basi appendicum antepenultimi paris prodeuntes, . . . posteriores apici appendicum penultimi paris affixae, inferne vergentes, triangulares, verticales, juxtapositae." But it is quite clear, however, from his statements on pp. 41 and 42 in the same work that this is not the case. He shows here that the part of the fifth limb which has been explained by me above, according to the so-called first method of explanation, as the third and fourth exopodite joints — it is described by G. O. SARS as a „tyndt og gjennemsigtigt membranøst Vedhang" (a thin, transparent, membranous appendage) — is most probably homologous to „den saakaldte Vifteplade (lamina vibratoria) paa det følgende Par Lemmer" (the so-called vibratory plate on the following pair of limbs). It is impossible to decide with certainty what is G. S. BRADY and A. M. NORMAN's view about this part of the sixth limb in their work of 1896. They have not made any distinct statement as to the homology of this organ — just as in the case of most of the other organs. In their description of *Cypridina* (*Vargula*) *norvegica* W. BAIRD we read on p. 648 with regard to this limb: „The penultimate limbs or third maxillae end in three setiferous lobes, the outer side of the limb carries a sub-triangular vibratory lamina, margined at first with nine plumose setae, beyond which the margin is simply finely ciliated, while near the further angle are three more plumose setae." The vibratory plate on the fifth limb is termed by these writers „vibratory plate". The similar terms perhaps indicate that these organs are considered to be homologous. It is possible, however, that these writers have not even attempted to form any opinion at all of the homology of these organs.

of bristles that is found in most cases on the posterior edge of the protopodite and that was taken by me above to be a remains of a vibratory plate appears, according to a statement on the same page, to belong to a reduced vibratory plate. This assumption has later been adopted by G. W. MÜLLER. Neither of these two authors has tried, however, to give any proof for their views. — With regard to the morphological value of the vibratory plate — just as in the case of the same organ on the fifth limb — we find two different views in the literature; most writers — if they have any opinion in this matter — take it to be an exopodite; G. W. MÜLLER assumes that it is homologous to an epipodial appendage. The backward pointing part of this limb, the part which is rod-shaped in Halocyprids, Cyprids, Darwinulids, Nesideids and Cytherids, is taken by all writers to be an endopodite. With regard to this limb in the family *Cypridinidae* G. W. MÜLLER assumes, 1894, p. 68, that the proximal joint, with two endites, corresponds to the protopodite, the three distal joints to the endopodite. Curiously enough G. W. MÜLLER seems to have been very sure about the extension of the protopodite. Thus he writes on this point, loc. cit. „so ist es wohl unzweifelhaft, daß bei *Cypridina* das 1. Glied, welches an seinem Vorderrand 2 Höcker mit Borsten hat, als Stamm . . . zu bezeichnen ist“. The reason why G. W. MÜLLER and I have arrived at somewhat different ideas as to the morphological value of this limb in the family *Cypridinidae* is probably to be found in our different explanations of the fifth limb in this family. Just as I have done above, G. W. MÜLLER has completely applied the homologization of the fifth limb to the sixth one. Other investigators too have assumed that the distal part of the sixth limb in the Cypridinids corresponds to the endopodite, but they have not indicated the exact boundary between the protopodite and the endopodite.

Seventh limb.

Seventh limb: — This is not found in the *Polycopidae* and *Cytherellidae*.

Cypridae, Darwinulidae, Nesideidae and Cytheridae.

The families *Cypridae*, *Darwinulidae*, *Nesideidae* and *Cytheridae*: In these families the seventh limb shows such a far-reaching agreement with the two preceding limbs that it seems to me that there are no serious objections to applying quite the same homologization to this limb as well. According to the first method of explanation the backward pointing rod-shaped branch is to be considered as an exopodite, according to the other it is to be taken as an endopodite and the part situated proximally of this branch is homologous to the protopodite. No organ is ever developed that could be considered as an endopodite according to the first method of explanation. The vibratory plate, which according to the first explanation is to be homologized with an epipodial appendage, according to the second with the exopodite, is always reduced; it can, however, be traced in most cases as single bristles on the posterior side of the protopodite, situated sometimes proximally, sometimes distally. No endites are developed.

Halocypridae.

It seems impossible to decide with certainty at present whether the very much reduced seventh limb in the Halocyprids is to be taken as a protopodite + an exopodite or only as an exopodite, according to the first method of explanation, or as a protopodite + an endopodite or only as an endopodite, according to the second.

Cypridinidae.

It is rather probable that the peculiar worm-like cleaning organ in the family *Cypridinidae* is also to be taken as a rod-shaped limb consisting of a protopodite and

an exopodite, according to the first method of explanation, or of a protopodite and an endopodite, according to the second; there is, is course, no proof of this as yet.

In the previous literature this limb has always been taken as being composed of a protopodite and an endopodite.

Is it possible to prove that any of the explanations put forward above is quite certain?

Which of these methods of explanation is correct?

The most important point in this question is: What is the nature of the vibratory plate in these three limbs? Is it to be considered as an epipodite or is it homologous with the exopodite? As has been shown above, this organ has been taken as an exopodite by almost all the preceding investigators; only G. W. MÜLLER has explained it as an epipodial appendage. No decisive proof of either of these views has been given so far; only a few writers have tried to give any reasons at all for their assumptions.

G. W. MÜLLER writes as follows in his large monograph of 1894, p. 84 with regard to this problem: „Wie ist sie zu deuten? CLAUS spricht sie als Außenast an, und diese Deutung scheint die nächste mit Rücksicht auf die Athemplatte der vorhergehenden beiden Gliedmaaßen zu sein, welche wir ebenfalls als Außenast auffaßten. Doch ist dagegen zu bemerken, daß der Ursprung derselben an den verschiedenen Gliedmaaßen ganz verschieden ist. An der 5. und 6. Gliedmaaße entspringt sie sehr weit oben am Stammglied; betrachten wir sie als Exopodit, so müssen wir annehmen, daß das 1. Stammglied vollständig oder fast vollständig geschwunden ist. Bei *Polycope* scheint die Zugehörigkeit zum 1. Stammglied außer Frage zu sein, jedoch lege ich diesem Befund geringen Werth bei mit Rücksicht auf die Schwierigkeit der Untersuchung und die Unsicherheit der Deutung bei der genannten Form. Abgesehen hiervon ist noch gegen diese Deutung einzuwenden, daß wir bei *Cytherella* außer der Athemplatte einen Anhang finden, der seiner Lage nach wohl nichts anders als ein Exopodit sein kann. Ein ähnlicher Anhang findet sich, wie gesagt, bei *Macrocypris*. Durch dieses Vorkommen scheint mir die Deutung der Athemplatte an der 5. und 6. Gliedmaaße als Exopodit widerlegt; ich bezeichne sie daher als Epipodialanhang.“ A part of this statement merits a closer examination.

First — I mention this in passing — G. W. MÜLLER's statement that he thought it certain that the vibratory plate on the maxilla was homologous with the exopodite. This statement must seem rather curious to those who have carefully read this writer's statements on this point in other places in the work quoted. It is true that in dealing with the vibratory plate on the maxilla in the family *Cypridae* this organ was first explained as an exopodite, but there was clearly a certain amount of doubt; thus we read on p. 57: „vielleicht ist sie als Außenast zu betrachten“. Lower down on the same page, however, G. W. MÜLLER seems to have followed quite another line of thought; we read here of the same organ: „Eine wesentlich andere Auffassung vertritt CLAUS . . . . die Athemplatte läßt er dem Exopodit entsprechen und homologisirt sie dem Anhang am 1. Tasterglied von *Cypridina*.“ According to this statement one would think that G. W. MÜLLER disagrees definitely with the explanation of the vibratory plate of the maxilla as an exopodite. His statement about the vibratory plate of the maxilla on p. 194 of this work: „Außenast . . . der . . . zur Athemplatte wurde (?)“ also seems to show that this writer was very doubtful about explaining this organ as an exopodite.

As a matter of fact — as has been already shown on p. 35 above — it must be considered that the morphological value of the vibratory plate on the maxilla (in the families *Cypridae*, *Darwinulidae*, *Nesideidae* and *Cytheridae*) is far from being settled with certainty. It is true that in this work I have explained this organ as an epipodite, but I did so with reserve; the possibility of its being of the nature of an exopodite must still be considered as being present. Under these circumstances, in homologizing the vibratory plates on the three posterior limbs it is not convenient to pay too much attention to the results attained so far in attempting to homologize this organ on the maxilla.

To support his view that the vibratory plate on the posterior limbs is an epipodial appendage G. W. MÜLLER thus brings forward, in the first place, the proximal position of this organ on the fifth and sixth limbs. As a matter of fact, however, the position of this organ on the posterior limbs varies rather considerably. In a number of forms this plate is certainly situated very proximally, as, for instance, on the fifth and sixth limbs of Halocyprids, on the fifth limb of *Nesidea* and on the fifth, sixth and seventh limbs of Cytherids (cf. the accompanying fig. V: 1 of the fifth limb of *Sclerochilus contortus* [A. M. NORMAN]); in other forms, however, we find it situated rather near the distal boundary of the protopodite, as, for instance, on the sixth and seventh limbs in *Nesidea*; cf. the accompanying fig. V: 2 (G. W. MÜLLER, 1894, pl. 15, fig. 35), on the fifth and sixth limbs of a number of Cyprids; cf. fig. IV: 7 above of the fifth limb of *Macrocypris*, and on the sixth limb of the family *Cypridinidae*, fig. VII above. (If G. W. MÜLLER's explanation of the joints on the fifth limb of the subfamily *Cypridininae* is correct, the vibratory plate is also attached close to the distal boundary of the protopodite on this limb as well; cf. p. 46 above and G. W. MÜLLER, 1894, p. 60, fig. 2.) In those cases where the vibratory plate is situated proximally we need not, however — even presupposing that it is of the nature of an exopodite — by any means resort to so radical an explanation as G. W. MÜLLER has adopted, namely that the „1. Stammglied vollständig oder fast vollständig geschwunden ist" (and there is just as little need to explain the distal position of this organ — presuming it is of the nature of an epipodial appendage — by assuming that the distal joint of the protopodite has more or less completely disappeared). As has already been pointed out above, the vibratory plate (probably always = the epipodite) on the mandible is often more or less displaced; in a number of forms it is situated on the medial side of the second protopodite joint, in others on the lateral side of this joint; in other words the position of the vibratory plate is not always quite constant. If we apply this experience to the posterior limbs, we need consequently only assume — if we suppose that the vibratory plate on these limbs is of the nature of an exopodite — that in forms in which the vibratory plate has a decidedly proximal position this organ is displaced proximally more than is usual. (Whether we assume that the vibratory plate is an exopodite or an epipodial appendage, it seems to be necessary for us to assume that this organ has been displaced in one direction or the other in a number of forms.)

As another argument G. W. MÜLLER puts forward the occurrence of a forward pointing process distally on the protopodite of the fifth limb of *Cytherella* and *Macrocypris*. The significance of this process must not, however, be overestimated; no decisive value can be attached

to it; it may very well be considered as an accessory appendage. Neither the position, size nor structure of this process form any decided argument in favour of its being a branch. The position is explained by its function; it is an organ for breaking up food or carrying it to the mouth or towards the masticatory appendages that are situated in front; the distal endite on the maxilla has about the same position. The size is of very little value as an argument; in this connection it will be enough to point out that the endites on the maxilla are often of considerable length, sometimes almost as long as the palp that has been explained as an endopodite. The structure seems to be an argument against, rather than for, its having the nature of a branch; it is always unjointed, in most cases not even bounded proximally; (a proximal boundary need not, as a matter of fact, have much significance, as I have myself observed specimens of a species belonging to the genus *Macrocypris* in which the middle one of the three endites of the maxilla had a well-defined proximal boundary); finally it is practically always without muscles inside itself — contrary to the backward pointing branch; I only succeeded in observing these muscles in the Halocyprids; cf. below, however, for the latter characters.

This investigator does not bring forward any other reasons for his view.

It ought to be clear from this that G. W. MÜLLER has not proved in any decisive way the assumption put forward by him as to the morphological nature of the vibratory plate on the three posterior limbs.

On the other hand we find that none of the investigators who adopt the view that the vibratory plate on the posterior limbs is of the nature of an exopodite has advanced any decisive proof for his view. The only one who has made a serious attempt to support his assumption by facts is G. ALM. This investigator has advanced a number of facts which seemed to him to support the idea that the forward pointing process on the fifth limb of a number of Cyprids and of Cytherella has the nature of a branch. We read in this writer's work of 1915, pp. 9—10: „Diese Bildung entspricht doch was Form und Lage anbelangt den Kauladen am Mandibel und der Maxille, zumal sie auch an der Innenseite des Beines sitzt, was nicht für den Exopodit gelten dürfte, und weiter vermißt man vollkommen etwaige Muskeln in derselben, was alles gegen die Deutung als Exopodit sprechen muß."

I have tried to show above that the shape and position of this process cannot be used as proofs of its having the nature of a branch, but these characters are equally incapable of being used as evidence in favour of the opposite opinion. The position is distal on the protopodite, i. e. where one would expect to find it if it were a branch. It is true that it is always unjointed, but in connection with this it may be pointed out that the same thing is always true of the exopodite on the mandible, of which no investigator has yet denied that it has the nature of a branch. With regard to G. ALM's argument that this process has no muscles it may be pointed out, first, that these can be observed in the Halocyprids (cf. fig. 27 of *Conchoecia symmetrica* G. W. MÜLLER, in this treatise), secondly that muscles are also absent in the exopodite of the mandible of *Cypridinidae*, etc. G. ALM assumes in the same work, p. 10, that the strong development and individualization of the forward pointing process on the fifth limb of *Macrocypris* is connected with the fact that this limb is in this genus also used as a crawling leg and a climbing organ and in consequence of this „nicht so weit nach vorne verschoben werden kann.

wie es bei den höheren C y p r i d e n, wo der Endopodit keine Bedeutung hat, der Fall ist. Statt dessen muß alsdann der bei der Nahrungsaufnahme zu verwendende Teil verlängert werden, auch ist ihre Beweglichkeit von Nutzen, um nicht von den Bewegungen des übrigen Beines abhängig zu sein." It ought to be obvious that this assumption cannot be used as a proof of the accessory nature of the forward pointing process; as an assumption it may be taken for what it is worth.

As a proof for the exopodite nature of the vibratory plate there has also been advanced the early appearance of this organ during ontogeny, as in other Crustacean groups the epipodial appendages usually appear comparatively late. We should note, however, that the forward pointing process on the fifth limb is also developed rather early; in a number of forms it is even more powerfully developed relatively in the larvae than in the mature individuals. It is probably impossible to draw any conclusions from these facts as to the morphological value of these processes. The early appearance of these two organs during ontogeny is presumably due less to their great phylogenetic age than to the fact that they are both of vital importance even in the early larval stages. E. KORSCHELT and K. HEIDER state in their „Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere", p. 389, that it can by no means be considered impossible that the early or late appearance of the epipodial appendages is closely connected with the needs of respiration.

N o r e a l l y d e c i s i v e e v i d e n c e i n f a v o u r o f e i t h e r o f t h e a l t e r n a t i v e s m e n t i o n e d c a n t h u s b e s a i d t o h a v e b e e n b r o u g h t f o r w a r d s o f a r, n o r, i n m y o p i n i o n, i s i t p o s s i b l e a t p r e s e n t t o f i n d a n y. I have myself tried to find evidence both among the facts of comparative morphology and in embryology, but without any positive result. It seems most probable to me, however, that G. W. MÜLLER has found the most correct solution of this problem. In the present treatise the vibratory plates on the fifth, sixth and sevenths limbs have consequently been taken to be epipodial appendages.

What was most decisive in causing me to take this view was the structure of the fifth limb in the family *Polycopidae*. It is true that the assumption that the two distal, verruciform, unjointed processes on this limb really correspond to an exopodite and an endopodite has not yet been proved; it is only a postulate put forward by G. W. MÜLLER even with the addition of a query, and no forms have been found so far that have enabled this statement in any way to be changed into a proof. But it seems to me, however, as is pointed out above, fairly probable that this assumption of G. W. MÜLLER's is correct. It seems to be supported partly by the fact that the P o l y c o p i d s show primitive characteristics with regard to the preceding limbs, partly because both these processes seem to appear constantly in all the forms belonging to this group, partly also perhaps because they are moved by special muscles in the same way. If these two processes are homologous with the exopodite and the endopodite, the vibratory plate must of course, as has been pointed out above, be taken as an epipodial appendage. The shape of the vibratory plate in this group also seems to me to support the idea that it is of the nature of an epipodial appendage.

This view is perhaps also supported by the fact that the forward pointing process on the fifth limb is developed best in a number of forms which are at the present time looked upon

as more or less primitive in a number of respects, as, for instance, in Polycopids, Halocyprids, Macrocyprids and Cytherellids.

Finally the fact that the vibratory plates on the mandible and maxilla are presumably of an epipodial nature may also be advanced to support this explanation. With regard to the value of this argument see p. 52 above.

If we start from the assumption that the vibratory plates on the fifth, sixth and seventh limbs are homologous with epipodial appendages, how is that part of these limbs to be explained that is situated distally of the protopodite and is often pointed backward and rod-shaped? Is it to be looked upon as an exopodite or an endopodite? And how is the forward pointing process on the fifth limb to be explained?

The position of these organs in relation to the limb as a whole does not — I think — permit of more than one explanation, the one which has already been put forward by me and called the first method of explanation. According to this the forward pointing process on the fifth limb is to be homologized with the endopodite; the part that is in most cases rod-shaped and pointing backward corresponds to an exopodite that is turned somewhat backward.

This is opposed to the results of all previous investigators; in all previous works, as is seen above, the distal part of these limbs has been explained as the endopodite. In the case of those investigators who homologize the vibratory plates on all limbs with exopodites this result is quite natural. But it seems to me exceedingly curious that G. W. MÜLLER, who has interpreted the vibratory plates on the three posterior limbs as epipodial appendages, should have been able to arrive at this result.

What arguments can G. W. MÜLLER bring forward in favour of a homologization of the two branches of the fifth limb that is quite the opposite of what is assumed by me above?

It is quite clear that the position of these organs does not support this view. G. W. MÜLLER writes with regard to this, 1894, p. 196: „Nicht unerwähnt will ich lassen, daß die Art der Einlenkung die umgekehrte Deutung befürwortet, doch wird man auf diese Thatsache wenig Werth legen, mit Rücksicht darauf, daß es nur einer geringen Verschiebung, einer schwachen Verbreiterung des Stammes an der betreffenden Stelle bedarf, um die heutige Form herzustellen.“ In other words this author admits that the position shows his explanation to be quite incorrect. At the same time, however, he tries to diminish the value of the evidence of the position by stating that a slight displacement of the parts in question would be enough to produce a position that would be suitable for the homologization accepted by him. When the foliaceous fifth limb of the Phyllopods is in a position of rest, the endites and the endopodite are pointing obliquely inwards and forwards towards the mouth; the exopodite is pointing obliquely backwards and outwards. On the foliaceous fifth limb in the family *Cypridinidae*, when the organ is in a position of rest, the endites point forwards and inwards, the part that G. W. MÜLLER explained as an endopodite points obliquely backwards and outwards. On the same limb in the Cyprids and Cytherellids the process that was explained by G. W. MÜLLER as an exopodite is, when the limb is in a position of rest, pointing inwards and forwards; the rod-shaped branch which was explained by the same author as an endopodite, points backwards. The homologization carried out by G. W. MÜLLER thus makes

it necessary simply to assume that the exopodite and the endopodite have changed places; the endites on the protopodite have, on the other hand, retained their original position. An alteration of position of this sort can scarcely be described as „gering"!

The explanation adopted by me, on the other hand, makes it necessary for the different parts to have retained their original position in a number of forms, e. g. in the families *Cypridinidae* and *Sarsiellidae*; in the families *Halocypridae, Cypridae, Darwinulidae, Nesideidae, Cytheridae* and *Cytherellidae* the rod-shaped branch would have been turned somewhat backwards, a turning that seems fairly easy to explain when one considers the comparatively great length of this branch in these forms and the presence of a shell that encloses the whole body; other parts have retained their original position in these groups too.

There seems to have really been only one argument present for G. W. MÜLLER in favour of this homologization, namely the resemblance that he believed he had observed between the rod-like distal parts of the three posterior limbs and the endopodites of the anterior post-oral limbs. Thus he writes, 1894, p. 84: „Die Uebereinstimmung im Bau des Innenastes der genannten Gliedmaaßen scheint mir von einigem Interesse. Bei der 2. Antenne unterliegt es keinem Zweifel, daß der fragliche Theil wirklich der Innenast ist; anders bei der 5.—7. Gliedmaaße. Mögen andere Gründe die fragliche Deutung sehr wahrscheinlich machen, mir scheint der stärkste Grund in der Uebereinstimmung des fraglichen Theiles mit dem Innenast der 2. Antenne zu liegen." I cannot decide with certainty which characters this writer is here referring to. A more detailed comparison between these limbs will, in my opinion, convince anyone who has a thorough knowledge of this group of animals that any resemblance that may be observed must be said to be so superficial that it cannot properly be put forward as „evidence" in this matter.

In an essay entitled „Mittheilungen über Copepoden", 1893, W. GIESBRECHT writes as follows p. 92: „Man kann im Allgemeinen (vorbehaltlich einer Reihe von Ausnahmen) die äußere Hälfte der vorderen Gliedmaßen des Rumpfes als die locomotorische und respiratorische, die innere als die prehensile bezeichnen." This statement was only observed by G. W. MÜLLER after his large Naples monograph of 1894 was nearly all in print and seems to have aroused in the mind of this author some doubt as to the explanation of the posterior limbs of the Ostracods that he had accepted in this work, but, all the same, it did not cause him to depart from the position he had already taken up. He writes on this point in the abovementioned work, p. 195: „Der Gesichtspunkt, von dem GIESBRECHT bei seinem Satz ausging, ist wohl dazu geeignet, Zweifel an der Richtigkeit der pag. 84 vorgetragenen Auffassung der Gliedmaaßen zu erwecken. Doch liegen die Verhältnisse bei den Ostracoden in einer Beziehung anders. Das Vorhandensein einer 2klappigen Schale begünstigte die Ausbildung desjenigen Astes zum Bewegungsorgan, vor allem zu einem solchen, das aus der Schale hervorgestreckt wurde, welcher der Mittellinie am nächsten stand, also des Innenastes. Eine Thatsache scheint von diesem Gesichtspunkt aus beachtenswerth: wir finden nur einen umfangreichen Anhang, den wir mit Bestimmtheit als Außenast bezeichnen können, und der im Dienste der Bewegung steht, das ist der Außenast der 2. Antenne der *Myodocopa*, und für diesen existiert fast durchweg eine Erweiterung der Spalte zwischen beiden Schalen oft als querer Schlitz (Rostralincisur), um ihm Spielraum für seine Bewegung zu schaffen. Dieser Gesichtspunkt

scheint beachtenswerth für die morphologische Deutung der Gliedmaaßen der Ostracoden. Freilich für entscheidend für die Auffassung gerade des fraglichen Beinpaares halte ich ihn nicht. Es sind da zahlreiche Möglichkeiten zu berücksichtigen: so kann die Gliedmaaße in den Dienst der Nahrungsaufnahme getreten sein, bevor die Schale den heutigen Umfang erreicht hatte, oder es kann der eine Ast sich an der Nahrungsaufnahme betheiligt haben, bevor der andere als Klammer- oder Schreitorgan Verwerthung fand, was durch die geringe Größe des nach hinten gerichteten Astes bei den Halocypriden und Cypriden eine gewisse Wahrscheinlichkeit gewinnt. Die Zahl der in Betracht kommenden Möglichkeiten ließe sich leicht vermehren; aber bei der Unmöglichkeit, sich für die eine oder andere zu entscheiden, wird man am besten thun, ähnliche Gesichtspunkte bei der Frage nach der Deutung der Aeste aus dem Spiel zu lassen. Die Aehnlichkeit der Aeste verschiedener Gliedmaaßen liefert immerhin noch den sichersten Anhalt."

With regard to this statement of G. W. MÜLLER's we may first point out the justice of his objection to a quite uncritical application to the limbs of the Ostracod group of the rule observed by W. GIESBRECHT for the anterior limbs in the Copepods. The conditions in these two groups are certainly so different that what is a rule in one may very well be an exception in the other. On the contrary, every special case must be tested by itself as thoroughly as possible. The necessity of this is probably best illustrated by the second antennae of the Ostracods.

On the other hand there is, as far as I can see, no evidence at all for G. W. MÜLLER's statement that the development of the epimeres on the posterior cephalomeres into a shell enclosing the whole body favours the development of the inner branch into a locomotory organ. It can scarcely be thought that the shell was any absolute obstacle to an increase in the length of an exopodite that was pointing obliquely backwards and outwards. At most, as is pointed out above, this branch was forced by the shell to turn slightly backwards. The „evidence" in favour of this statement of his obtained by the author from the exopodite of the second antenna in Cypridinids, Halocyprids and Polycopids is, of course, almost too weak and transparent to need further discussion. To judge from the reservation he added, G. W. MÜLLER himself realized this weakness. It will probably be sufficient to point out that the exopodite of this antenna is used as a locomotory (natatory) organ, even in such forms as have no rostral incisur, e. g. in *Polycopidae* and *Thaumatocypris*. The rostral incisur is not to be considered as a structure that makes it possible for the exopodite on this antenna to be used as a locomotory and natatory organ, but as a structure by means of which the second antenna alone, without the help of the first antenna, may be able to fulfil the function of a locomotory (natatory) organ; for this it is necessary that this limb shall be moved, not in the sagittal plane, but straight outwards from front to back. This has already been pointed out by G. O. SARS, 1865, p. 6 (cf. chapter III of this work). With regard to the useless nature of the rest of the above statement I am quite in agreement with its author.

I can thus merely keep to my view as accepted above with regard to the explanation of these branches. In arriving at this I have been practically confined to the relative position of the parts. In these cases other characters have almost entirely failed. Thus in the present work the method of explanation accepted for the [illegible]

sixth and seventh limbs is that which is put forward above and called the first method of explanation. It is perhaps best illustrated by the fig. IV given above.

A few more words may be added here with regard to the three posterior limbs in the families *Halocypridae*, *Cypridae*, *Darwinulidae*, *Nesideidae* and *Cytheridae*.

As is mentioned above, almost all writers assume that in the *Crustacea* the rod-shaped limb has always or almost always arisen from the biramous type by a reduction of the exopodite; upon this reduction the endopodite became — according to a number of writers — „was es am Blattbein war: zur direkten Fortsetzung des Protopodites" (W. GIESBRECHT, 1913, p. 32). If the explanation adopted by me above is correct, the fifth, sixth and seventh limbs of the five families mentioned above would thus form an important exception to a general rule. (It is, however, to be noted that in the case of the limbs of *Leptostraca* J. THIELE, 1905, p. 449 arrived at a result similar to that obtained by me above; this investigator writes (loc. cit.): „Die übrigen Körperanhänge: vorn die vordere Maxille, die Mandibel und die hinteren Antennen, hinten die beiden letzten Pleopoden haben den einen ihrer beiden Äste verloren, an den vorderen Anhängen wahrscheinlich den äußeren, an den hinteren vielleicht den inneren, etc."). This cannot, however, be considered surprising by those who, like myself (p. 24), take the view that there was probably no far-reaching morphological difference originally between the different parts of the limbs in *Protostraca*.

In exceptional cases the rod-shaped limb would have developed directly from the foliaceous type. (Even in these cases the distal part of the limb would be homologous with the endopodte). As examples of such a development W. GIESBRECHT, 1913, mentioned, as is seen from p. 24 above, the rod-shaped fifth, sixth and seventh limbs in the five Ostracod families just mentioned. This assumption of GIESBRECHT's must be regarded as very problematical. It is, of course, connected with this author's homologization of the vibratory plates on these limbs with the exopodites. If we accept my view that this organ is of an epipodial nature, the problem is obviously different; at least for the present it seems best to leave this assumption out of consideration.

Copulatory organs: —

I was doubtful as to the terms I should use for the male copulatory organs in the Cypridinids.

We know that in this group the two vasa deferentia unite distally and open on an unpaired, papilla-like little swelling situated medio-ventrally somewhat in front of the furca. On both sides of this papilla there issue two more or less extensive appendages, in most cases bifurcated distally; these are the organs of copulation. These two organs do not include any part of the ducts of the sexual organs; they are nevertheless called penes by C. CLAUS, G. W. MÜLLER and others; no special reason for this terminology is given. A. RAMSCH, 1906, most frequently calls them penes, sometime genital limbs. On the other hand A. GARBINI, 1887, calls these organs „zampe sessuali"; only the small papilla on which the sexual ducts emerge is called penis by this writer.

If the state of affairs had been the same in other Ostracod groups as in the Cypridinids it would undoubtedly have been most convenient to denote the small median

genital papilla as a penis, as A. GARBINI has done; the copulatory organs might have conveniently been called „genital limbs“ or something similar. We know, however, that this is not the case. On the contrary, in other groups* the distal parts of the ducts of the sexual organs do not emerge between the copulatory appendages, but more or less distally on them; in other words the latter are to be taken as real penes.

The question now arises: are the copulatory organs in the Cypridinids homologous to the same organs in other Ostracods. It is exceedingly difficult to answer this question; a multitude of facts from comparative morphology and embryology, which unfortunately I cannot yet give, are necessary for this answer. G. W. MÜLLER does not attempt to give any definite answer to this question. He writes, 1894, p. 77: „. . . . So beschränke ich mich hier darauf, die verschiedenen Möglichkeiten der Homologisirung des Penis, die ich kenne, aufzuzählen, ohne damit behaupten zu wollen, daß damit alle Möglichkeiten erschöpft sind. 1) Der Penis der Cypridiniden ist das umgewandelte 8. Gliedmaaßenpaar und dem bürstenförmigen Organ der *Podocopa*, nicht aber dem Penis der übrigen Ostracoden (einschließlich der *Podocopa*) homolog. Der Penis der letzteren ist nicht aus einem Gliedmaaßenpaar hervorgegangen. Hierfür ließe sich das verschiedene Verhalten des Penis bei den Cypridiniden und den übrigen Ostracoden anführen. Bei den Cypridiniden nimmt er keinen Theil des Vas deferens auf, sondern steht nur neben der Mündung. Bei den übrigen Ostracoden umfaßt er den Endtheil des Vas deferens, ist selbst Begattungsrohr. 2) Der Penis der Cypridiniden ist aus einem Gliedmaaßenpaare hervorgegangen, das sich bei den *Podocopa* gespalten und den Penis nebst dem bürstenförmigen Organ geliefert hat, während bei den Halocypriden und Polycopiden nur die eine Hälfte erhalten ist. 3) Der Penis der Cypridiniden ist aus 2 Gliedmaaßenpaaren hervorgegangen, von denen das eine den Penis der Halocypriden, Polycopiden und *Podocopa*, das andere das bürstenförmige Organ der *Podocopa* geliefert hat. — Ich finde keine Gründe, welche die eine Annahme wahrscheinlicher machen, als die andere.“ As for several reasons I am fully convinced that the copulative organs are homologous formations in the whole Ostracod group — I regard the conditions in the Cypridinids as primitive — it seemed to me best to use the term penes for these organs, thereby following the terminology accepted by most previous investigators.

It will be necessary in the future to define and amplify the special terminology for this organ very considerably. The reason why this is not done here is that in the present work this organ is dealt with very superficially. The complicated structure of this organ needs a very thorough and comprehensive examination, a piece of work that probably needs a special treatise.

Gills: —

I shall only mention in passing A. DOHRN's hypothesis (Geschichte des Krebsstammes) that the gills in the genus *Asterope* are homologous with epipodial appendages of limbs, the other parts of which have now entirely disappeared. No proof of this assumption can be given, but it also seems, at least at present, impossible entirely to disprove it. It may, however be pointed out that it seems much more probable that we are only concerned with accessory folds of the skin without any connection originally with limbs; (on the other hand it is quite uncertain.

* The state of affairs in *Polycopidae* is unfortunately not known with certainty.

whether these folds are arranged segmentally or not). Fr. MÜLLER, 1870, p. 273, had already expressed this view; as did C. CLAUS also, 1876, p. 96. As a proof of the probability of this assumption it may be pointed out that weak transverse folds have been observed on the dorsal side of the back of the body in the males of a number of species belonging to other genera of Cypridinids: cf., for instance, *Cypridina dorsoserrata* G. W. MÜLLER, 1908, pl. IV, fig. 2. In the male of *Cypridina Hilgendorfi* G. W. MÜLLER, 1890, we find at the corresponding place gills in the form of comparatively high transverse folds, seven in number; as in the last-mentioned species but contrary to the genus *Asterope*, these folds extend across the back without any median break; only the foremost one has a medial concavity. G. W. MÜLLER, 1890, p. 224, homologizes these gills with those of the genus *Asterope*, supporting his view especially by their number and position. It is, at any rate, certainly premature at the present time to describe these gills by the term „epipodial appendages".

Furca.

Furca: —

With regard to this organ the terminology used by G. W. MÜLLER has been adopted in this work. Consequently the furcal claws are counted distally-proximally, contrary to the practice of a number of other writers, e. g. G. S. BRADY. This method is necessitated partly because in several forms these claws vary in number, when it is always the small proximal claws that are subject to variation, and partly because they are formed ontogenetically distally-proximally, the proximal ones not appearing until the mature stage is reached.

Frontal organ.

Frontal organ*: —

This is most frequently termed in the present work „the rod-shaped organ", on account of its shape.

Other organs.

With regard to other organs the terminology used by G. W. MÜLLER has been adopted in this work.

The larval stages.

Terminology of the larval stages: —

By Stage I in the present work is meant the oldest larval stage, the stage next to the mature stage. The stage immediately preceding Stage I is called Stage II, the stage immediately preceding Stage II is Stage III, and so on.

This terminology has not been used by previous writers. C. CLAUS and G. W. MÜLLER denote the youngest freely living larval stage by Stage I, the subsequent stage by Stage II, and so on. This terminology seems inconvenient on account of the deficiency of our present knowledge of the post-embryonal development of this group, especially with regard to the youngest larval stages. A consequence of the employment of this terminology has been that larval stages with the same numbers do not correspond to each other in the works of different writers or even in different works of the same writer. Thus Stage I of the genus *Conchoecia* in G. W. MÜLLER's works of 1893 and 1894 — of which this author says, 1893, p. 376, „Das erste mir bekannt gewordene Stadium, das ich geneigt bin, für das erste überhaupt zu halten" — corresponds to Stage III of the same genus in C. CLAUS, 1893.

* Contrary to the practice in G. W. MÜLLER's works, in this treatise, as in W. GIESBRECHT, 1913, the nauplius eye is not reckoned as a frontal organ (W. GIESBRECHT, 1913, p. 120). G. W. MÜLLER writes, 1912, p. 8: „Das Frontalorgan . . . besteht aus dem dreiteiligen Medianauge und . . . ."

It is true that G. H. FOWLER in his work of 1909 counts from the older to the younger stages, as I do, but he denotes the oldest mature stage, not the oldest larval stage, as Stage I. As a result of this the oldest larval stage in the genus *Conchoecia* is termed Stage III in this work, as this writer assumes that this genus is characterized by two mature stages which differ from each other. It is to be noted that in several Ostracod groups moults — characterized by small growth-factors and inconsiderable morphological alterations — occur after maturity is attained. So far, however, we do not know which groups are characterized by post-larval moults; it is not impossible that different species in the same genus differ from each other in this character. Nor do we know how many larval moults the different species are characterized by. From these reasons it may be evident that it is not convenient to follow the terminology used by G. H. FOWLER.

CHAPTER II.

Contributions to our knowledge of the natural system of the Ostracods.

During the course of the last century zoological classification has, as we know, — like the biological sciences in general — shown an enormous advance. The cause of this is probably to be found especially in the way in which the idea of evolution has asserted itself in biology. The purely descriptive classification, whose main — and in many cases only — object was to try to get an arrangement and summary of the multitude of forms belonging to organic life, has given way to deeper and more scientific efforts. Natural scientists have laid down as their object an attempt to establish, by means of comparison, the laws of the phenomena in the animal and vegetable kingdoms and an attempt to arrive at an understanding of these phenomena by means of exact methods and experiments.

It is true that even C. v. LINNÉ spoke about „natural“ and „artificial“ systems, but it was only after the theory of evolution was put forth that the idea arose that a real consanguinity existed between the different systematic categories. The motto was formulated that „the degree of resemblance is a measure of consanguinity; the greater the resemblance is, the closer are the genealogical bonds, the greater the difference becomes, the farther away is the common original form“.

During the first decades after DARWIN's epoch-making work „On the Origin of Species“, 1859, the main interest of zoologists was directed to comparative morphology and embryology; they tried to obtain from these departments of study facts that might explain the genetic position of the different groups of animals. But it was the great increase of interest in the field of theoretical speculation as to evolution that probably left the greatest impression on this period of investigation. Both experts and laymen often devoted themselves freely to far-reaching speculations, hypotheses were often constructed on hypotheses, facts were often made to fit in with hypotheses previously arrived at. During this time the „pedigree“ of the animal world was constructed and the hypothetical original forms of the different groups were re-constructed.

Gradually, however, there came a natural reaction against this mania for speculation. During the last few decades the interest of biologists has been concentrated more and more on more exact methods of investigation, especially experimental investigation. With the watchword „More facts, less theory" scientists have attacked, with brilliant results, such problems as the conception of species, variability, heredity, the factors that produce species, etc. Beneath the pressure of the multitude of facts discovered by scientists during this period a great deal of the bold speculative fabric of the preceding period has collapsed piece by piece; many „pedigrees" and hypothetical original forms have been proved to be untenable.

As a result of this reverse theoretical classification has been neglected, perhaps even more than it deserved. A number of investigators have even expressed a wish that classification should quite get rid of the theory of evolution and that it should only have as its aim a good characterization and a lucid arrangement of the organic world; in other words they desire a return to the tasks that the classifier formerly looked upon as his.

It is certain that this is going too far. Only after the introduction of the principle of evolution into classification can the latter be said to have been raised to the level of a science. To separate these two things would certainly be a retrogressive step. I should like to quote in this connection a statement of L. PLATE, 1914, p. 109: „Von jeder größeren systematischen Abhandlung sollte man erwarten, daß sie mit phyletischen Betrachtungen abschließt und alle zurzeit vorliegenden Beobachtungen aus dem eigenen Untersuchungsgebiet und aus verwandten Disziplinen (Anatomie, Embryologie) zusammenträgt und nach dieser Richtung hin prüft".

In dealing with the theoretical problems connected with evolution it seems to be most convenient to retain the method of working out hypothetical original forms — a crystallization of the qualities that are assumed to be original — and „pedigrees" — graphical presentations of the hypothetical genetic position of the different systematic units. The argument may gain considerably in clearness by the use of this method. But a far deeper criticism must be made than was formerly the case; the hypotheses must be founded on a very broad basis of facts; it is best to stop when the facts cease to furnish distinct evidence.

I shall attempt below to give an exposition of the natural system and the history of the evolution of the Ostracods according to the results given by previous writers and by my own studies of this group of animals.

In all the works published before 1850 the Ostracods were divided directly into genera. In this year there appeared W. BAIRD's important work „Natural History of the British Entomostraca", in which this group of animals was divided into three families:

Family I. *Cypridae* with the genera *Cypris* and *Candona*
„ II. *Cytheridae* „ „ „ *Cythere* „ *Cythereis*
„ III. *Cypridinadae* „ „ genus *Cypridina*.

In J. D. DANA's large work on the *Crustacea* collected by the „United States Exploring Expedition" another important advance is to be noted, as the Ostracods are here divided into two families, both of which are again divided into two sub-families:

Family I. *Cypridae*, with the sub-families *Cyprinae* and *Cytherinae*
„ II. *Halocypridae*, „ „ „ *Cypridininae* and *Halocyprinae*.

This classification may be said to form the basis for the present system of the Ostracods.

On the basis laid down by J. D. DANA G. O. SARS went further. The classification used by this latter author in his work „Oversigt af Norges marine Ostracoder", 1865, is particularly noteworthy, partly because it established two new main groups based on forms quite or almost quite unknown to previous writers, partly because in this work the names now used for the large main groups were used for the first time. This writer divides the Ostracods into four main groups, comprising six families altogether:

Sectio I. *Podocopa*, comprising the families *Cypridae* and *Cytheridae*.
„ II. *Myodocopa*, „ „ „ *Cypridinadae* and *Conchoeciadae*
„ III. *Cladocopa*, „ „ family *Polycopidae*
„ IV. *Platycopa*, „ „ „ *Cytherellidae*.

Most of the investigators who have worked in this field have adopted the foundation of the Ostracod system as accepted by G. O. SARS without any alteration at all. G. W. MÜLLER, who is undoubtedly our greatest Ostracod expert, has, on the other hand, somewhat modified this system. In his large monograph on the Ostracods of the Bay of Naples he has returned to the classification into two main groups adopted by J. D. DANA. On p. 202 in this work he classifies the Ostracod world as follows:

Tribus I. *Myodocopa*, comprising the families *Cypridinidae*, *Halocypridae* and *Polycopidae*
„ II. *Podocopa*, „ „ „ *Cypridae*, *Nesideidae*, *Cytheridae*, *Cytherellidae* and *Darwinulidae*.

In other words, of G. O. SARS's four groups G. W. MÜLLER combines *Cladocopa* and *Myodocopa* on the one hand and *Platycopa* and *Podocopa* on the other. In his later works too, even in the one published most recently, 1912, G. W. MÜLLER uses this classification. Only one writer has adopted his view, namely T. R. R. STEBBING in a work of 1910.

Only one author, namely C. CLAUS, entirely rejects the main classification adopted by G. O. SARS. While G. W. MÜLLER states in 1894, p. 188, that „die gesammten Ostracoden sondern sich in zwei scharf getrennte Unterordnungen — *Podocopa* und *Myodocopa*", we find the following statement in C. CLAUS's work of 1876, p. 97: „Sie" *(Cypridinidae)* „würden den Cytheriden und Cypriden des süßen Wassers gegenüber in eine besondere Unterordnung zu bringen sein, wenn nicht die marinen Halocypriden in der inneren Organisation den Cypridinen nahe verwandt, im Bau der Gliedmaßen unmittelbar zu jenen beiden Familien hinführten und somit als Uebergangsgruppe eine schärfere Scheidung der aufzustellenden Unterordnungen verhinderten". C. CLAUS also defends the same view in his later works, e. g. 1891 a, p. 6. We thus see that this writer divides the Ostracod group directly into families.

Are we to consider that any of these three authors, G. O. SARS, C. CLAUS and G. W. MÜLLER, is correct? In other words which fundamental classification of the Ostracods is to be considered most natural?

In answering this question it will be best first to try to show which characters in the Ostracods are to be regarded as primitive. Or in other words what was the organization of the original Ostracods, the Protostracods? On what lines has the development of the Ostracods proceeded?

The organization of the Protostracods.

In investigating these problems we get no help at all from palaeontology. Representatives both of G. W. MÜLLER's group *Podocopa* and of *Myodocopa* are probably found even in Lower Silurian. Almost always shells alone are known.

It is very difficult to draw any conclusions as to the structure of the Protostracods from the organization of other Crustacean groups, as our knowledge of the genetic position of the Ostracods is anything but certain. I shall only give here as examples the views of two of our foremost Crustacean investigators.* C. GROBBEN assumes, 1892, that the Ostracods and the Cladocers have come from the same forms as the *Conchostraca*, while Copepods, Cirripeds and *Branchiura* are more closely related to *Notostraca*, and *Leptostraca* and *Malacostraca* are joined to *Anostraca*. W. GIESBRECHT assumes, on the other hand, 1913, pp. 230—233, that *Phyllopoda Anostraca*, *Notostraca* and *Conchostraca*, *Cladocera* and *Ostracoda* form a special branch from *Protostraca* and that the Ostracods have branched out from this „als dieser in der Richtung auf die Phyllopoden etwas über die Abgangsstelle der Copepoden hinausgewachsen war". Thus, according to this writer, *Phyllopoda Anostraca*, *Notostraca* and *Conchostraca* and *Cladocera* are comparatively closely related to each other; on the other hand they are comparatively remote from the Ostracods even though they are nearer to this group of animals than any other recent Crustacea. According to W. GIESBRECHT it is difficult or even impossible at present to decide which of the four groups just mentioned is most closely related to the Ostracods.

The prevalent uncertainty in our knowledge of the organization of the *Protostraca*, the hypothetical primitive forms of the Crustacea, ought also to be mentioned. I shall only point out here the uncertainty with regard to the structure of the limbs of these forms. It may be sufficient in this connection to refer to what is written on this problem on pp. 22—24 above. The main object of this somewhat detailed exposition is to give the reader an idea of the great uncertainty with regard to this important problem.

In dealing with the problem of the organization of the Protostracods we are thus entirely or at any rate almost entirely confined to a comparison of the morphology and embryology of the recent Ostracod groups.

It ought perhaps to be pointed out at the very outset that the result of this investigation is bound to be rather uncertain, both on account of the great difficulties of the problem and the uncertainty and incompleteness of our knowledge with regard to much that concerns the organization and embryology of these groups of animals.

The only author who has closely studied the problem of the organization and development of the Protostracods is G. W. MÜLLER. In his large monograph of 1894, pp. 191—199 this writer has given a very detailed account of the results he obtained during these investigations. Other authors touch on this question more cursorily; I need only mention here among

* Cf. also C. CLAUS's view, 1876, p. 91 and W. GIESBRECHT's [illegible]

these, C. CLAUS and G. ALM. For this reason it seemed to me that the most obvious course in discussing this problem was to put my answer into the form of a criticism of G. W. MÜLLER's exposition of the results gained by him.

G. W. MÜLLER depicts the life, organization and development of the Protostracods on the whole as follows:

Life.

The Protostracods were freely swimming organisms, but did not travel far from the bottom, often attaching themselves to hydrophytes „ohne indessen umherzukriechen"*.

They already had a calcified shell which enclosed the whole body and which was shut by a closing muscle which went through the body. The shell was „vermuthlich" characterized by a rostral incisur „für den Austritt des Außenastes der 2. Antenne" and by an arched ventral margin.

The body was segmented externally; there were at least eleven segments behind the head, of which only some had limbs.

A heart was developed. The alimentary organs were of the same simple type as in the recent Cypridinids. There were well-developed compound lateral eyes and an unpaired median eye divided into three parts.

There were eight pairs of limbs, and a ninth had perhaps already become employed as a copulatory organ. Only four of the limbs belonged to the head; the appendage corresponding to the second maxilla of other *Crustacea* was absent.

The first antenna had eight joints. It was probably most similar to that of the recent Cypridinids, which is a sensory and a locomotory organ at the same time. „Von einer solchen Form konnte sich ebensowohl die vorwiegend der Bewegung dienende Form der *Podocopa*, wie die ausschließlich oder fast ausschließlich als Sinnesorgan fungirende mancher *Myodocopa* entwickeln. Unzweifelhaft hat ein Wechsel, der zum Ueberwiegen der einen oder anderen Function geführt hat, wiederholt stattgefunden."

Second antenna: — This had a two-jointed protopodite and a well-developed endo- and exopodite. The endopodite was four-jointed, the exopodite composed of a rather large number of joints. Of the recent Ostracods the Polycopids would have the most primitive second antenna; these forms would differ from the original type chiefly in the structure of the protopodite. The protopodite of this limb would have had a very different fate in the Cypridinids, Halocyprids and Polycopids on the one hand and in the other Ostracods on the other. In the former groups the two protopodite joints have pointed in the same direction and then gradually have been quite united to each other. In the latter the protopodite was distinguished by the fact that the two joints together formed an upward pointing knee; in most of them it became single-jointed afterwards by the total disappearance of the distal joint; this joint is still found only in the genus *Cytherella*. In the Cypridinids and the Halocyprids the endopodite is more or less completely reduced. „Daß bei einer fast ausschließlichen Verwerthung der 2. Antenne als Schwimmfuß

* G. W. MÜLLER writes, p. 198, that they were „in der Lebensweise den Halocypriden am nächsten". When he wrote this, he was of the opinion that the Halocyprids live chiefly at the bottom and „nur zeitweilig schwimmend aufsteigen", 1894, p. 13; of course he gave up this opinion later on.

der Innenast schwindet, scheint verständlich, denn er verdankt seine Erhaltung als kleiner Rest nur der Function als Greiforgan beim ♂ und dürfte diese bereits bei der gemeinsamen Stammform der *Myodocopa* besessen haben."

From being natatory animals without any power of crawling the original forms of the group termed by G. W. MÜLLER *Podocopa* developed into crawling organisms. During this the exopodite was reduced. „Dies führte zur Ausbildung des Innenastes zu einem nach vorn greifenden, den Körper nachziehenden Fuß. Dieser Function entsprechend bildete sich ein scharfes Knie zwischen dem 1. und 2. Stammglied aus, an dessen Stelle später durch Ausfall des 2. Stammgliedes das Knie zwischen Innenast und Stamm trat. Weiter hatte sie die Verschiebung des Ursprungs nach vorn und die Ausbildung eines besonderen Fortsatzes, auf dem die 2. Antenne entspringt, zur Folge. — Vielleicht war bei dieser Art der Bewegung der Außenast geradezu hinderlich, jedenfalls entwickelte sich der Innenast stärker; er bewahrte sich den Antheil am Schwimmen, wobei er durch die 1. Antenne unterstützt wurde. Rückbildung des Außenastes und Betheiligung der 1. Antenne am Schwimmen stehen in enger Beziehung zu einander: eines ermöglichte das andere. Die weiteren Veränderungen der 2. Antenne bei den *Podocopa* . . . bestehen in einem Verlust der Schwimmborsten und in einer Streckung."

Mandible: — In the Protostracods this was composed of „einem Basalglied mit Kaufortsatz und einem 4gliedrigen Taster".* The peculiar type of endite found on the first protopodite joint of the Cypridinids, like the powerful endite on „the first palp joint" in the Halocyprids seems to be a later acquisition „die wir bereits bei den Polycopiden vorbereitet finden". The palp in the Cypridinids, which is „umfangreich, sehr beweglich und eventuell eine hervorragende Rolle als Bewegungsorgan spielt" is taken by this writer to be of a more primitive type than the palp in the forms that are grouped by him under the name of *Podocopa*, which is „mäßig groß, wenig beweglich und nicht oder sicher nur wenig zur Bewegung hilft". „Vielleicht stand er zunächst fast ausschließlich im Dienst der Nahrungsaufnahme und betheiligte sich dann bei der Gewöhnung an ein Leben im Grund als Grabfuß an der Fortbewegung. Bei den *Podocopa* dürfte er auch ursprünglich umfangreicher und geeigneter zum Ergreifen und Festhalten der Nahrung gewesen sein." The reduction of the palp in the latter forms would have been connected with the development of the second antenna as a crawling leg in these forms. G. W. MÜLLER gives no information as to the type of the exopodite of this limb in the Protostracods. *Mandible.*

Maxilla: — G. W. MÜLLER stated that it seemed to him more probable that this limb had originally a three-jointed protopodite with three endites or at least a protopodite with three endites than a two-jointed protopodite with two endites; in other words it seemed to this writer more probable that two of the endites have been united than that a cleavage has taken place. Endopodite: This had three joints. The exopodite was small; in a number of forms the exopodite disappeared, in others it became a vibratory plate. The most primitive type is represented by the *Polycopidae*. *Maxilla.*

* One might imagine from this statement that G. W. MÜLLER assumed the existence of a [illegible] podite and a four-jointed endopodite. This is, however, not the case, as it is clear from what is said [illegible] erste Tasterglied" is taken by this writer as the second protopodite joint.

F i f t h l i m b: — This appendage would have been of about the same type as that of *Macrocypris*, a recent genus belonging to *Cypridae*, but it was probably furnished, however, with a vibratory plate of about the same type as that which characterizes this limb in the H a l o c y p r i d s. Its protopodite would have been fairly large and to a rather great extent united to the body. Distally-anteriorly the protopodite would have been furnished with a short process (explained by G. W. MÜLLER as the exopodite). Its exopodite*, which pointed backwards and was fairly long, was four-jointed, with a small end-joint armed with three bristles. This limb would have been used partly in taking up food and partly as a locomotory organ „(Anklammern?)". During its further development sometimes one and sometime the other of these two functions was prominent. When the former function predominated the forward pointing process on the protopodite was almost always completely reduced. When the taking up of food became the principal function of this limb it was necessary, owing to the reduction of the forward pointing process, for the limb to move forward to the boundary between the head and the trunk of the body *(Cypridae)* or even right up to the hypostome *(Cypridinidae* and *Halocypridae)*, so that owing to its position it came to look like a limb of the head. In the males of the ancestors of the families that are placed by G. W. MÜLLER in one group under the name of *Podocopa* the exopodite of this limb would have been already developed as an auxiliary organ in copulation.

Sixth limb.

The s i x t h l i m b would in the P r o t o s t r a c o d s have borne the closest resemblance to this appendage in the females of the H a l o c y p r i d s. This limb of the C y p r i d s, D a r w i n u l i d s, N e s i d e i d s and C y t h e r i d s has been adapted to a crawling life and especially on account of this has been lengthened. With regard to this limb in the C y p r i d i n i d s G. W. MÜLLER says that it is „nichts weniger als eine ursprüngliche Form". „Bei den P o l y c o p i d e n ging in Folge der starken Reduction der Körpergröße dieses, sowie das folgende Beinpaar verloren."

S e v e n t h l i m b: — This appendage, which has two principal functions in recent forms, namely those of a cleaning or a crawling organ, was already a cleaning organ in the primitive forms and had about the same type as in the recent C y p r i d s. We find it developed as the most complete cleaning organ in the C y p r i d i n i d s; its chief task is to keep the brood-chamber clean. In the H a l o c y p r i d s it was originally a more perfect cleaning organ than in the recent C y p r i d s; it was then reduced, „in Folge des Aufgebens der Brutpflege?". In the N e s i d e i d s and C y t h e r i d s it became exclusively an organ of locomotion.

V i b r a t o r y p l a t e s: — These are arranged as follows in the recent O s t r a c o d s: In *Cypridinidae* and *Polycopidae* on the fifth limb, in *Halocypridae* on the fifth and sixth limbs, in other O s t r a c o d s they are situated farther forward, on the mandible and the maxilla, less frequently on the fifth limb as well, in exceptional cases *(Cytherella)* on the sixth limb. G. W. MÜLLER assumes that the P r o t o s t r a c o d s had vibratory plates on the fifth and sixth limbs of about the same type as in the recent H a l o c y p r i d s or perhaps on the fifth, sixth and seventh limbs. When these organs were reduced on the posterior limbs similar ones would have appeared „compensatorisch an Mandibel und Maxille". As evidence for this opinion

* Exopodite according to this author's interpretation.

this author points to the reduced vibratory plates on the posterior limbs in *Nesideidae* and the conditions in the C y t h e r e l l i d s.

Brush-shaped organ

The b r u s h - s h a p e d o r g a n is considered by this writer to be homologous with an eighth limb. This limb would have been found in both males and females of the P r o t o s t r a c o d s and have belonged to the segment behind that of the seventh limb. The position of this organ near or just behind the fifth limb is considered to be a secondary one.

Furca.

The f u r c a of the P r o t o s t r a c o d s would have been of about the same type as this organ in *Conchoecia*.

Sexual organs

This author does not express any opinion about the s e x u a l o r g a n s.

Rod-shaped organ

In this connection he does not mention the r o d - s h a p e d o r g a n either. It is merely stated on p. 161 that this organ is „lediglich“ homologous in C y p r i d i n i d s and H a l o c y p r i d s.

A criticism of G. W. Müller's view of the Protostracods.

Although this view of the life, organization and the development of the P r o t o s t r a c o d s, as worked out by G. W. MÜLLER, is very meritorious, it is, nevertheless, open to criticism in many details.

How did the Protostracods move?

According to this author the P r o t o s t r a c o d s swam freely. H o w d i d t h e y s w i m?

We can distinguish three types of swimming in the recent O s t r a c o d s; first the method of swimming found among C y p r i d i n i d s and most H a l o c y p r i d s, secondly the method of swimming in the C y p r i d s and P o l y c o p i d s, and thirdly that found in the genus *Thaumatocypris*. The C y p r i d i n i d s and most of the H a l o c y p r i d s use what one might call rostral incisur swimming. They do not use the first antenna as a natatory organ, a fact that was pointed out by G. W. MÜLLER in 1894, p. 23: „irgend welchen Antheil an der Schwimmbewegung nimmt hier die 1. Antenne sicher nicht.“ I have also been convinced of the correctness of this observation by examination of living animals. It is to be noticed, in addition, that the structure of this antenna makes it anything but suitable for a natatory organ. Thus G. W. MÜLLER writes, 1894, p. 24: „Auch ihr Bau macht mir eine Mitwirkung daran wenig wahrscheinlich.“* On the other hand the second antenna, which is the only natatory organ of these forms, is particularly well suited by its organization to fulfil this function. It is very powerful, its protopodite is very large and full of powerful muscles which move the exopodite. This is long and cylindrical and is fitted with long, powerful natatory bristles and joined very loosely to the protopodite. Each valve in these forms is furnished anteriorly with an incisur, the rostral incisur, and in swimming the exopodite rests with its basal joint in this almost as an oar rests in a rowlock.** In swimming the exopodite moves almost straight out at the sides and backwards, only slightly downwards; in this way a straight forward motion of the animal is produced. The endopodite of this limb is more or less reduced in these forms and does not play any part in swimming. In the C y p r i d s that have no rostral incisur both the first and the second antenna take part in swimming. The first antenna is long, cylindrical

* G. S. BRADY and A. M. NORMAN assume, however, 1896, p. 625, that this [illegible] swimming.

** Of course I do not mean by this that the action in this kind of swimming [illegible]. On the contrary this is not at all the case.

and armed with numerous long, powerful natatory bristles; in swimming this limb strikes powerfully upwards and backwards and somewhat outward. The second antenna is a combined crawling and swimming organ. Its exopodite is reduced and does not seem to take part in swimming, or at any rate it does so only slightly. The function of swimming is carried out by the endopodite, which is furnished with a cluster of long, powerful natatory bristles distally on the first joint. In swimming this limb is moved powerfully downwards and backwards and somewhat outward. By the combination of the upward and backward natatory movements of the first antenna and the downward and backward movements of the second antenna the animal is propelled straight forward. The same principle of swimming is found in the Polycopids. These forms also have no rostral incisur. Their first antennae are certainly rather short, but are furnished with long, powerful natatory bristles and in swimming strike upward and backward, somewhat outward. The second antenna is of about the same type as this appendage in the Cypridinids, but its endopodite is better developed and is provided with long, powerful bristles. In swimming both the exo- and the endopodite are used; they both strike powerfully downward and backward and somewhat outward. In this they are assisted by the maxilla; this limb is provided with long and rather powerful bristles both at the end of the exo- and the endopodite and, like the second antenna, it strikes powerfully downward and backward in swimming. In *Thaumatocypris* too, in which we find the third method of swimming, there is no rostral incisur. This genus has a first antenna of about the same type as is found in the Cyprids and a second antenna of about the same type as that of the Polycopids. In swimming both the first and the second antenna strike downward and backward (and probably somewhat outward). Such a method of swimming would obviously cause the animal to have a rotatory motion if there were not special means for preventing this. We have such means, however, in the long spines that issue from the shell (cf. the chapter on the adaptations for planktonic life in this treatise).

Did the Protostracods use any of these three methods of swimming?

G. W. MÜLLER himself does not give any direct information with regard to this. From some statements in his monograph of 1894 we can, however, indirectly get an idea of this writer's opinion on this subject. As we have seen above, he assumed that the first antenna of the Protostracods resembled that of the Cypridinids most closely. As in another part of this work he has pointed out that this antenna, on account of its structure, is not suitable as a natatory organ and has himself discovered that it is not used as such, he could not have been of the opinion that this appendage took part in the operation of swimming in the Protostracods. He thus seems presumably to have meant that in the latter only the second antenna acted as a natatory organ, i. e. he seems to have had the idea that these animals swam about in the same way as the recent Cypridinids. That this was really his opinion is also shown by the fact that he assumed the rostral incisur to be a character belonging to the Protostracods. (Cf. also p. 67 above.)

Did the Protostracods have any rostral incisur? G. W. MÜLLER himself does not give any reasons at all for his assumption that they had. But this assumption needs to be proved in more detail even perhaps more than most of the others.

G. W. MÜLLER seems to have suspected the weakness of this assumption himself, as he writes „vermuthlich" before it. In dealing with this problem the following facts ought to be noted: There are only two groups among the recent Ostracods, namely the Cypridinids and the Halocyprids, which are characterized by having a rostral incisur. The Cyprids, Darwinulids, Nesideids, Cytherids, Cytherellids and Polycopids of which the latter group is considered, presumably correctly, to be rather primitive in many respects, and *Thaumatocypris*, presumably the most primitive genus among the Halocyprids, have not this peculiarity in their organization. The rostral incisur in the Cypridinids is presumably not homologous with that of the Halocyprids. In the Halocyprids the rostral incisur has been partly formed by the outer lamella of the shell having been bulged out like a finger of a glove into a sort of rostrum near the dorsal boundary of the anterior margin of the shell; the margin of the shell continues, as G. W. MÜLLER himself pointed out in his monograph of 1894, p. 101, in the form of an s-shaped bent line, „Buchtlinie" (C. CLAUS), situated basally on the inside of the rostrum. In the Cypridinids, on the other hand, the incisur is formed simply by a concavity of the anterior margin of the shell. In the face of these facts and as there seem to be no reasons to support G. W. MÜLLER's assumption, it does not seem too bold to draw the conclusion that the rostral incisur is not a character which belonged to the Protostracods.*

Whe thus see the failure of the strongest — and as far as I can see the only — argument in favour of assuming that the Protostracods had a method of swimming of the same type as that of the recent Cypridinids. There is, in addition, at least one more reason that seems to contradict this assumption. G. W. MÜLLER assumed that the second antenna of the Protostracods had both the exopodite and the endopodite well developed and that both these branches were used in swimming (cf. G. W. MÜLLER, 1894, p. 199); this antenna seems to resemble most closely the recent Polycopids. The assumption that the second antenna originally had both the exopodite and the endopodite well developed seems to me justified; there are several arguments in favour of this. First, the exopodite dominates in a number of forms (Cypridinids and most of the Halocyprids), while the endopodite dominates in others (Cyprids, Darwinulids, Nesideids and Cytherids), secondly, a number of forms, *Thaumatocypris*, Polycopids and Cytherellids, have a second antenna with both the exopodite and the endopodite well developed. On the other hand it seems to be very unlikely that the two branches took part in swimming, at least if we assume the same method of swimming for the Protostracods as

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* In this connection I ought perhaps to mention the statement put forward by C. CLAUS, 18[illegible], p. [illegible], to the effect that the deep concavities found behind the „ear-shaped lobes" anteriorly on the shells of larvae of the Decapod genus *Euphausia* are recurrences of the rostral incisurs in Cypridinids and Halocyprids that are of great value phylogenetically. This author writes as follows on this point: „Von Interesse scheint mir das Vorhandensein zweier ohrförmiger Lappen an dem als Kragen bezeichneten Abschnitt der Panzerduplicatur. Eine tiefe Einbuchtung, hinter jedem der beiden Seitenlappen ist eine Wiederholung des Ausschnittes an der Schale der Cypridinen und Halocypriden, und weist mit vielem anderen darauf hin, daß wir den Malacostrakenpanzer und die Schalenbildungen der Entomostraken von gleichem Ausgangspunkt abzuleiten haben." I give this statement for what it is worth. I ought perhaps to mention, however, the great variation shown in the shape of the shells of larvae belonging to *Malacostraca*. Why should just the peculiar type of shell in this genus be of great [illegible]

that which characterizes the recent Cypridinids; there are both anatomical and mechanical reasons against this. This method of swimming seems to presuppose the dominance of the exopodite. This circumstance seems also to have been noticed by G. W. MÜLLER; this author writes, 1894, p. 193, as follows:* „Daß bei einer fast ausschließlichen Verwerthung der 2. Antenne als Schwimmfuß der Innenast schwindet, scheint verständlich, denn er verdankt seine Erhaltung als kleiner Rest nur der Function als Greiforgan beim ♂ und dürfte diese bereits bei der gemeinsamen Stammform der *Myodocopa* besessen haben." It will probably be sufficient to point out in this connection that all the forms that swim in this way (all the Cypridinids, all the genera of Halocyprids except *Thaumatocypris*) have the endopodite reduced; this branch does not help as a natatory organ. On the other hand, in *Thaumatocypris* and the Polycopids, which are, as we know characterized by another method of swimming, both the exopodite and the endopodite are always well developed.

It seems to me most probable that the rostral incisur swimming is a later acquisition. It even seems not impossible that this method of swimming has arisen and been developed independently in the two groups, Cypridinids and Halocyprids. This idea seems to be decidedly supported by the fact that *Thaumatocypris*, the genus that is in many respects the most primitive of all the Halocyprids, does not have this method of swimming, but swims in quite a different way. It must, of course, be considered as very improbable — not to say entirely impossible — that the Cypridinids diverged from the Halocyprids after *Thaumatocypris*.

Can we assume that any other of the three methods of swimming described above as occurring in the recent Ostracods is primitive in this group?

It seems to be impossible to assume that the method of swimming that characterizes the genus *Thaumatocypris* is original; as far as I can see this method needs long processes on the shell (cf. below, the chapter on adaptation to a planktonic life) and such processes could scarcely have characterized the shells of the Protostracods.

There remains consequently only the method of swimming that we found as characteristic of the Polycopids and a number of the Cyprids. But it does not seem possible to consider this either as primitive in the Ostracods, as both the position of the Polycopids and the Cyprids in the Ostracod system and the details in the development of this mode of swimming seem to support very decidedly the idea that this mode of swimming has arisen and been developed independently in these two groups.

Is it not really at least equally probable that the ancestors of the Ostracods were not freely swimming but crawling forms — although their powers of crawling were not quite so well developed as in a number of recent forms, e. g. Nesideids and Cytherids? By this I do not, of course, mean to state decidedly that they had a crawling life and that they lacked all power of swimming, but I only wish to point out that this possibility does not seem to me excluded. Before we have succeeded in showing quite definitely that this possibility is out of the question it does not seem right to put forward an assumption that the opposite state of affairs is the correct one — at least the matter should not be put in such as definite way as

* I [illegible] altogether out of consideration the illogical deduction in this statement.

G. W. MÜLLER has done. On the contrary, the facts of the case will probably make us admit that it is still impossible to express our opinions with any great degree of certainty on this important problem, that of the mode of locomotion of the Protostracods.

S h e l l: — G. W. MÜLLER's assumption that the Protostracods had a calcified shell, enclosing the whole body, and that it was shut by a muscle that went through the body, is probably correct. At least it seems to be supported by the fact that almost all the recent Ostracods so far known are distinguished by a shell of this sort. With regard to the assumption that the shell was characterized by a rostral incisur I shall only refer here to what has been said on this matter above, p. 71. It seems at present to be impossible to decide as to the correctness of the assumption that the shell had an arched ventral margin, which was gradually flattened in a number of forms „entsprechend der kriechenden Lebensweise". G. W. MÜLLER has not produced any reason for this assumption and I cannot find any definite reason either for or against it. We can find shells with a flattened ventral margin both in swimming and in crawling forms. But the arched ventral margin predominates in the swimming forms, the flattened one in the crawling forms. Presumably the dorsal margin had no hinge teeth. *Shell.*

S e g m e n t a t i o n: — As is seen above, the body would have been segmented externally; at least eleven segments would have been developed behind the head, only a number of which had limbs. *Segmentation.*

In the same work, p. 18, G. W. MÜLLER points out that the recent Ostracods almost always lack external segmentation of the back of the body. Only in a single one of the genera investigated by him, the genus *Cytherella*, did this segmentation seem to exist. He writes as follows about this: „Nur *Cytherella* hat zu beiden Seiten der hinteren Körperhälfte eine Reihe von gelenkig verbundenen Chitinstücken. Diese stehen in keiner directen Beziehung zu den Gliedmaaßen, wie etwa die Chitinstützen der Cytheriden, das beweist schon ihre Zahl. Vielmehr haben wir in ihnen unzweifelhaft Reste einer Segmentirung zu sehen. Von den Gliedmaaßen bei den Weibchen von *Cytherella* gehört das einzige wohl entwickelte des Thorax, das wir als 4. postorales deuten, dem zweiten Segment an, dann wäre das 3. postorale auf den 1. gesonderten Ring zu beziehen. Es würden dann für den unsegmentirten Kopf 4 Gliedmaßen bleiben, die gleiche Zahl, die wir oben angaben. Gliedmaaßen lassen sich am Thorax der Ostracoden mit einiger Sicherheit 4 Paar nachweisen (außer den bekannten Gliedmaaßen betrachte ich als Gliedmaaßenrest das bürstenförmige Organ). Es würden dann beim Weibchen von *Cytherella* noch 7 Segmente ohne Extremitäten bleiben." A reference is given in the text to pl. 32, fig. 12, *Cytherella sordida*, G. W. MÜLLER, ♀. As far as I can discover, G. W. MÜLLER rests his assumption about the segmentation of the Protostracods exclusively on this genus, on a single species, or, more correctly speaking, on the female of a single species, *C. sordida*, of this genus. He has even only paid attention to the chitinous stripes he found on the back of the body in this form.

Unfortunately I have not had any opportunity myself of investigating closely any representative of this genus. In discussing this problem I was consequently confined to the description and figures given by G. W. MÜLLER.

Thus the fourth post-oral limb, or according to the terminology used in the present work, the sixth limb, of this species belongs, according to G. W. MÜLLER, to the segment represented by the second chitinous stripe. No reasons are given for this statement; we are obviously concerned with a purely external position. If we turn to the figure to which G. W. MÜLLER refer, we find a certain difficulty in finding the orientation of the limb mentioned in relation to the chitinous stripes; as G. W. MÜLLER himself points out, the latter are not directly connected with the limbs, as is the case in the Cytherids. It seems to me to be most closely connected with the most anterior of the chitinous stripes drawn in the figure. If we start from this orientation we shall find nine more „segments“ come after this „segment“, i. e. the number given by G. W. MÜLLER himself. (The most anterior chitinous stripe in this figure would thus represent the second „segment“, the most anterior one not being drawn). If we compare with this pl. 32, fig. 5, which represents the back of the body of the male *Cytherella sordida*, we find the following facts. The orientation of the sixth limb is, if possible, more difficult than in the figure of the female. It seems to be most closely connected with the next to the most anterior chitinous stripe. If we start from this orientation, only five more „segments“ would come after the „second segment“, i. e. four less than the number given by G. W. MÜLLER; if we assume that this limb belonged to the anterior chitinous stripe, the number of „segments“ that follow would be three less than the number given by this author. In the male the number of the chitinous stripes at the back of the body is, at least if we are to judge from G. W. MÜLLER's figures, considerably smaller than in the female.

Under these circumstances it is probably somewhat premature to draw conclusions as to the number of the segments in the Protostracods from the number of these chitinous stripes and to assume that the latter are remains of an original segmentation. Is it not equally likely that we are not concerned with a primitive segmentation, but with secondary chitinous stripes developed as a support for the movements of the back of the body? This assumption seems to me to be supported by the fact that these stripes are developed differently in males and females. In the males, in which the back of the body presumably has a relatively limited power of movement on account of the great development of the penis, the number of these stripes is considerably less than in the females, in which the back of the body is not obstructed in its movement by an appendage of this size. The difference in the shape of the stripes in males and females is also perhaps an argument in favour of this assumption. Chitinous stripes as a support for the movements of various organs are a fairly common phenomenon in the Ostracods. (Other species of *Cytherella* dealt with by other writers are unfortunately so incompletely described that it is impossible to take them into consideration in this question.)

In a number of Cypridinids we find on the back of the body a number of transverse folds. Whether these are remains of external segmentation is also uncertain. The number of these folds is different for different forms. Cf. also the bristles and hairs on the back of the body of the Polycopids (G. W. MÜLLER, 1894, pl. 7, figs. 26 and 50).

The result of the above discussion seems to be that it is still too early to answer the problem as to the conditions of segmentation in the Protostracods. Whether this problem will ever be able to be solved I must leave undecided. In any case more far-reaching

and comprehensive arguments than those put forward by G. W. MÜLLER are an absolute necessity. Above all the question as to whether the nervous system may, in spite of its changed condition, possibly afford some information on this subject must be investigated.

Heart and eyes. The assumption that the Protostracods were characterized by a heart, lateral eyes and an unpaired median eye with three parts seems to me very probable. It is now generally considered, as we know, that these organs belonged to the *Protostraca*. Other writers previous to G. W. MÜLLER expressed similar views to his. As early as 1859 E. GRUBE pointed out, p. 326, that the genera *Cypridina* and *Asterope* resembled the *Cladocera* by their lateral eyes, among other things. C. CLAUS, in his work of 1865, p. 147, stated that by having a heart and by the development of the organs of sight *Cypridina* resembled the Daphnids; from his later works it is also clear that he considered these characters as being primitive for the Ostracods. Finally it may be pointed out that F. MÜLLER, 1870, p. 273, assumed that the Protostracods had a heart. In this connection it may also be pointed out that L. LÜDERS, 1909, pp. 117—118, assumes that the genus *Gigantocypris*, on account of its well developed system of blood-vessels and its development of blood-corpuscles, is to be considered as more primitive in this respect than other known Ostracods.

Alimentary organs. With regard to the assumption that the Protostracods had alimentary organs of about the same simple type as those of the recent Cypridinids it seems to me that no serious objection can be raised against it. We may note, however, that W. GIESBRECHT, 1913, p. 228, states that *Protostraca* presumably had metamere coeca on the middle part of the intestines „jedenfalls gab es coeca an seinem Vorder- und Hinterende". We find hepatic coeca among the Cypridinids *(Asterope)* and Halocyprids as well as among Cyprids, Nesideids and Cytherids.

Number of the limbs. The number of the limbs: — The assumption that the Protostracods were without the limb corresponding to the second maxilla of other *Crustacea* is connected with the assumption made by this writer, and some others, that the recent Ostracods never have this appendage. With regard to this question I only refer here to what has been shown in connection with this subject on p. 20 of this treatise; see also the brush-shaped organ and the penis.

Brush-shaped organ. The question of the nature of the so-called brush-shaped organ is very difficult to decide. It is perhaps a limb. But in this case which one?

In the Nesideids and the Cytherids this organ is always found in the males, never in the females; in these groups we find it most frequently in the neighbourhood of the fifth limb, sometimes a little in front of and sometimes a little behind it, but it is rarely found so far back as between the sixth limbs. Among the Cyprids it has so far been observed only in one genus, *Macrocypris*. It has also been found in *Cytherella*. In the two latter genera this organ is also confined to the males; it is not situated, however, at the same place as in *Nesideidae* and *Cytheridae*, but near or somewhat behind the seventh limb. Among the Cypridinids this organ has been observed by G. W. MÜLLER behind the seventh limb in the female of *Cypridina squamosa* G. W. MÜLLER. In all other species of this group, as in all the Halocyprids and Polycopids in which this organ was sought for, even in the forms investigated by me, it was not found.

It may, however, be pointed out here in passing that G. W. MÜLLER has assumed that the brush-shaped organ might possibly be found in the males of the Cypridinids; he writes as follows about this: „Man muß an die Möglichkeit denken, daß der Penis der Cypridiniden daraus hervorgegangen ist, oder daß es in den Penis aufgegangen ist und einen Theil desselben bildet. An dem Penis verschiedener Cypridiniden, nicht aller, läßt sich eine borstentragende Platte nachweisen, welche bei *Cylindroleberis*" (= *Asterope*) „entschieden an das bürstenförmige Organ erinnert, dem sie auch in ihrer Lage im Wesentlichen entspricht." Without entering in any detail into this difficult problem I will only point out that these assumptions are to be considered as, to say the least, very uncertain — a fact that has, of course, been admitted by G. W. MÜLLER himself. If we regard the penis in the Cypridinids as homologous to the brush-shaped organ, we pre-suppose, of course, that the former organ is not homologous with the penis in the Cyprids, Nesideids, Cytherids and Cytherellids. It is true that some investigators have denied the homology of these organs — because the penis in the Cypridinids does not include the vas deferens — but this view seems to be untenable for several reasons. It also seems to be very improbable that the bristle-bearing plate on, for instance, the penis of *Asterope* is homologous to the brush-shaped organ. It seems more probable that it represents one of the two branches of the biramous limb from which the penis probably has developed; cf., for instance, G. W. MÜLLER, 1894, pl. 5, fig. 41.

We thus find that the brush-shaped organ is situated in a number of forms close to the fifth limb, in others close to or behind the seventh limb. Are these homologous organs? G. W. MÜLLER is of the opinion that they are because of the similarity in shape of the organs in all the groups and also because in almost all the groups in which it has been observed, Cyprids, Nesideids, Cytherids and Cytherellids, it is confined to the same sex. I have nothing to add to this. At any rate the possibility is not excluded. The position behind the seventh limb is taken by G. W. MÜLLER to be the original one; the brush-shaped organ would represent the eighth limb. With regard to the cause of the hypothetical displacement this author writes as follows, p. 76: „Die Bedingungen, welche das Organ zwischen die anderen Beinpaare drängt, sind wohl in der Verkürzung des gesammten Körpers zu suchen. Nachdem es einmal zwischen die Beinpaare gerathen war, wurde es bei den Formen, welche seitlich stark comprimirt sind (z. B. *Paradoxostoma*) bei denen kein Platz mehr zwischen den der Mittellinie sehr genäherten Beinen blieb, bis vor das vorderste Beinpaar gedrängt." In support of the assumption that the position behind the seventh limb is the original one it may be pointed out that the forms in which this position has been observed are considered to be more or less primitive in several respects. It is perhaps also supported by the late appearance of this organ during ontogeny; it appears only „wenn alle Gliedmaaßen annähernd ihre definitive Form besitzen"; with regard to the last argument it may, however, be pointed out that reduced organs often appear comparatively late, as, for instance, the reduced second maxilla in the *Cladocera*. Other authors assume that the position in front of the fifth limb is original; according to these authors the brush-shaped organ would represent the second maxilla of other *Crustacea*. No reasons of any importance have been put forward in support of this view; on the other hand we must say, I think, that this possibility must be regarded as being present. This problem thus seems so far to be unsolved.

It seems to me very probable for several reasons that the penis is of the nature of a limb, as has been assumed by several investigators; I need only point out here the great resemblance this organ bears to a biramous limb in those forms in which it is characterized by a very simple structure, e. g. *Asterope, Philomedes,* (cf., for instance, G. W. MÜLLER, 1894, pl. 5, fig. 41) and that it is innervated in the same way as other limbs. *Penis*

First antenna: — This antenna would have had eight joints. The only reason for this assumption that I am able to find in G. W. MÜLLER's work is that this number is the largest that is observed in all the known Ostracods, „wir finden diese Zahl als höchste bei den *Podocopa* und *Myodocopa*". It seems to be impossible to accept this reason as in any way decisive. From the point of view of the theory of evolution one can of course equally well imagine a cleavage of joints as a union of them. Embryology does not support this assumption at all, nor does comparative anatomy. The only resemblance between this limb of a Cyprid and a Cypridinid is really the number of joints. Both the equipment of bristles and the musculature are so profoundly different that they do not seem to indicate that the different joints of this antenna in one group are homologous with the corresponding joints in the other. *First antenna.*

The same uncertainty applies to the assumption that this antenna was originally a sensory and a locomotory organ at the same time, „vielleicht glich sie am meisten der I. Antenne der Cypridiniden". According to the theory of evolution there can scarcely be any reason against an assumption that even a first antenna that was originally used exclusively as a locomotory organ might gradually develop as a sensory organ and vice versa. It may be pointed out that among the Halocyprids, in the majority of which the first antenna is exclusively or almost exclusively a sensory organ, the genus *Thaumatocypris*, which in many respects is to be considered as the most primitive, has a first antenna which, as far as one can see, serves exclusively or practically exclusively as a locomotory organ. As is seen above, G. W. MÜLLER assumes that during the course of development sometimes one and sometimes the other of these two functions has dominated.

In my opinion it is impossible at present to give an opinion with any great degree of certainty as to the type of this limb in the Protostracods.

Second antenna: — It seems to me probable that the protopodite of the second antenna in Cypridinids, Halocyprids and Polycopids is composed of at least two joints; traces of the original boundary between two joints have presumably been observed by G. W. MÜLLER in the Polycopids (1894, p. 39). On the other hand this author's view with regard to the protopodite in other forms seems to me far less probable. *Second antenna*

In an article „Mittheilungen über Copepoden", 1893, W. GIESBRECHT wrote as follows (p. 86) with regard to the maxilliped of the *Copepoda*: „Daß Glieder miteinander verschmelzen und die Gliederzahl sich auf diese Weise vermindert, läßt sich häufig nachweisen; aber wie Glieder verschwinden können, zumal relativ so umfangreiche und muskelerfüllte und so nützliche wie die Basalia, das hätte CLAUS doch irgendwie dem Verständnis des Lesers näher bringen müssen" . . . etc. However much ope nto criticism this statement may be, I should

like to start out from it in judging G. W. MÜLLER's view in this case. The latter writer assumes that in Cyprids, Darwinulids, Nesideids and Cytherids the distal protopodite joint has been quite lost. But where is the proof of this assumption? As far as I can see there is none. G. W. MÜLLER brings forward in this connection the fact that in the genus *Cytherella* the bending into a knee takes place between the first and second protopodite joints. But this does not prove this assumption. The fact that this formation of a knee in the second antenna in the Ostracods has actually taken place at different places — between the protopodite on the one hand and the exopodite and endopodite on the other in Cypridinids, Halocyprids and Polycopids and between two protopodite joints in *Cytherella* — may at least be explained by assuming that this limb of the Protostracods was of so primitive a type that no definite formation of a knee had as yet taken place. This assumption seems to be supported by the fact that this limb differs very much in its type in the different Ostracod groups. The genus *Cytherella* is comparatively far removed from all other Ostracods by its whole organization (G. O. SARS as we know distinguished this genus as a special group, parallel to *Myodocopa*, *Podocopa*, etc.). The ancestors of this genus presumably branched off from all the other Ostracods at a rather early period. Perhaps this differentiation even took place so early that the second antenna had not yet acquired a definite knee. At any rate this possibility must be regarded as being present. G. W. MÜLLER's view finds just as little to support it in embryology as in comparative morphology. I have never found any trace of the distal protopodite joint which, according to G. W. MÜLLER, has disappeared in larvae of Cyprids or other forms in which, according to this author, it is absent in the mature specimens. Nor has G. W. MÜLLER or any other investigator of this problem ever mentioned such a trace.

Moreover, according to G. W. MÜLLER's assumption, in the forms whose distal protopodite joint has disappeared the place on the body from which this antenna issues has developed into a joint-like process. What has caused G. W. MÜLLER to assume that this process, which resembles a joint very much by its type, has not been a part of this antenna from the very beginning? We are given no information at all as to this; I should like once more to quote from the above-mentioned work of W. GIESBRECHT. This author writes as follows with regard to the reduction of the basal joints of the maxillipeds that is assumed by C. CLAUS for the *Copepoda* (p. 86): „Wie ist dieser Verlust namentlich für den hinteren Maxillipeden zu begreifen, der doch durch seine Länge und die hohe Zahl (7) seiner Glieder bei den meisten der höher stehenden Copepoden zeigt, daß er eher einer Vermehrung als einer Verminderung seiner Gliederzahl bedurfte, als seine Function im Herbeischaffen von Nahrung zu bestehen begann?“ One must necessarily follow W. GIESBRECHT in trying to find out the reason for such a reduction in the number of joints. Why, one asks, has this limb, which needs to be relatively long in order to fulfil its supposed function as a locomotory organ, first reduced its length by the total disappearance of the second protopodite joint, and then (or at the same time?) made up for this loss in length by the development of an accessory process that does not belong to the original limb. Such a question as this may perhaps seem unscientific, but it seems to be forced inevitably on the reader's attention.

Why does not the proximal, joint-like process represent the first joint of a two-jointed protopodite? Or — if it were to appear that a similar process exists in the genus *Cytherella* as well, which does not seem improbable, first because of a drawing of this antenna given by G. W. MÜLLER, 1894, pl. 32, fig. 1, and secondly because of what I have observed myself in a preparation of a similar antenna* — why should we not assume a three-jointed protopodite? This number is as a matter of fact assumed by H. J. HANSEN as the original one for all the post-oral limbs of the *Crustacea* (cf. Zool. Anz. 1893, p. 194). In a new form (not described)**, closely related to the genus *Macrocypris* I observed that this basal part is composed of two clearly separated segments. Why then might it not be assumed that this process is homologous with the procoxale and the coxale, so that the large joint that follows is homologous with the basale? The formation of a knee would thus in these forms too have taken place between the basale on the one hand and the exopodite and endopodite on the other. As in the case of the mandible of the Cypridinids a ventrally pointing knee would have been developed between the coxale and the basale. Before it has been clearly proved that these homologizations are impossible we cannot accept the view put forward by G. W. MÜLLER.

G. W. MÜLLER's assumption with regard to the endopodite of this antenna of the Protostracods seems to me almost equally unfounded. This would resemble most closely this branch in the Polycopids.

The endopodite would have been four-jointed. According to G. W. MÜLLER's statements the recent Ostracods have the following number of joints on this branch. Leaving out of consideration forms with a more or less reduced endopodite, the Cypridinids have three joints. Among the Halocyprids the female (the male is unknown) of *Thaumatocypris*, which is in several respects presumably the most primitive genus, has only two joints; in the other forms of this group we always find in the males more or less distinctly three joints, in the females most frequently only two joints. The Polycopids, the group that would possess the most primitive second antenna, appear always to have three joints. The Cyprids sometimes have a four-jointed, and sometimes a three-jointed, endopodite; in the cases where a three-jointed endopodite is found the end joint has either more or less entirely disappeared or else the second joint has arisen by a union of two joints; traces of this union can still be observed in some forms. *Darwinulidae* has three joints; the second joint would have arisen by the union of two joints, but there seems to be no traces of this union present; no such traces are at any rate to be seen on figures hitherto published, nor are they mentioned either by G. W. MÜLLER or other writers. *Nesideidae* is characterized by four joints. The Cytherids have three or four joints — in the cases in which three joints are found the second joint would have arisen by a union of two joints; traces of this union can sometimes by observed. The *Cytherellidae* have three joints; the second of these would show „deutliche“ traces of a union (1894, p. 43); no such traces can, however, be found on the figure given by G. W. MÜLLER (1894, pl. 32, fig. 4), nor have I succeeded in observing any on a specimen investigated by me.

* The preparation was unfortunately defective.

** To be published in a following part of this work.

Are we to accept the homologization carried out by G. W. MÜLLER?

In answering this question I shall leave the Cypridinids, Halocyprids and Polycopids out of consideration and turn to the groups, on whose number of joints G. W. MÜLLER has obviously based the assumption mentioned above. *Macrocypris*, the genus that is considered as the most primitive among the Cyprids, is characterized by a four-jointed endopodite. Its second joint is comparatively long and has on the posterior edge, proximally of the middle, one or a couple of bristles, on the anterior edge, near the third joint, two bristles situated close to each other. The third joint is comparatively short and is moved by two muscles, a flexor and an extensor, both with a proximal attachment situated proximally in the second joint; this joint is always armed disto-anteriorly with a number of long, powerful claws. The fourth joint is small, issuing at about the middle of the posterior side of the third joint; it is moved by only one muscle, which has its proximal attachment proximally in the second joint; and it is armed distally with several bristles, one of which is a sensory bristle. In other genera belonging to the family *Cypridae* the state of affairs is often somewhat different. The postero-proximal bristle of the second joint is almost always lacking, but, on the other hand, this joint almost always has, as in *Macrocypris*, on the anterior edge two* bristles situated close together; only in exceptional cases does one of these bristles seem to be absent. In some species the boundary between the second and third joints has more or less completely disappeared. In a number of these forms the two muscles which we found moved the third joint in the genus *Macrocypris* are missing; in others, however, they can be found; distally-anteriorly this joint, as in *Macrocypris*, always has powerful, claw-like bristles. The fourth joint may be more or less completely reduced in a number of species, but even in those forms in which this joint has quite disappeared it always seems possible to distinguish by their position the bristles that belong to this joint from those that belong to the original third joint, as they are situated distally-posteriorly on the end joint and are separated from the bristles of the original third joint by a swelling in the chitinous wall of the joint; in some forms a distinct gap can also be observed between these two groups of bristles. In the family *Nesideidae* we find the following state of affairs: All the three recent genera of this family that have been described so far, *Nesidea*, *Bythocypris* and *Anchistrocheles*, have a four-jointed endopodite, of about the same type in all of them. The genus *Nesidea* (cf. G. W. MÜLLER, 1894, pl. XV, fig. 29): The second joint is moderately long and has only one or a few bristles situated postero-distally. The third joint is relatively long; it is not moved by special muscles and has, among other things, two bristles situated close together on the anterior edge a short distance from the distal boundary; distally-anteriorly this joint has no bristles at all. The fourth joint is short and is moved by two muscles, a flexor and an extensor, both having a proximal attachment proximally on the second joint; it is provided with five bristles, which, at least in a number of species, are situated in two groups, as I have had an opportunity of observing myself when investigating a couple

*) G. W. MÜLLER states, 1894, p. 40 that the Cyprids always have a single bristle at this place. „Das 2. Glied des Innenastes . . . . trägt constant eine kleine Borste am dorsalen Rand"; two bristles, are, however, drawn in the figures of several species belonging to this group that this author has given in this work. The statement made above is based on observations of a large number of species investigated by me.

of species belonging to this genus; cf. also G. W. MÜLLER, 1894, pl. 15, fig. 31. One of these groups is situated antero-distally on the joint and comprises two claw-like bristles, the other is situated postero-distally and consists of three bristles, one of which is a sensory bristle of about the same type as the sensory bristle of the fourth joint in the genus *Macrocypris* and other Cyprids. The two groups are separated from each other by a distinct swelling in the wall of the joint.

Can we, in the face of these facts, accept the homologization worked out by G. W. MÜLLER for these joints of these two families? I believe not. It seems far more probable — not to say absolutely certain — that the joints in the family *Nesideidae* that are denoted by G. W. MÜLLER as nos. 2 and 3 are homologous with the second joint in *Macrocypris*, the fourth joint in the Nesideids corresponds to the third and fourth joints in *Macrocypris*. If we assume this homologization we shall find the following points of agreement: The second joint is elongated; it has on the posterior side proximally of the middle one or two bristles and on the anterior edge somewhat proximally of the distal boundary two bristles situated close together. The third joint is relatively short; it is moved by two muscles, a flexor and an extensor, both of which have their proximal attachments proximally on the second joint; distally-anteriorly it is armed with claw-like bristles. In *Nesideidae*, as in several Cyprids, the fourth joint is completely reduced, but the bristles that belong to this joint can be distinguished from those of the original third joint by means of a swelling in the wall of the joint; one of the bristles of the fourth joint is a sensory bristle. In other words the agreement is complete. The lack of resemblance if we accept G. W. MÜLLER's homologization is as striking as the similarity if we accept that worked out above. The same correction must also be made in G. W. MÜLLER's homologization of the endopodite of the second antenna in the Cytherids. This will indicate the degree of certainty in the facts on which G. W. MÜLLER has based his assumption with regard to the number of joints in the endopodite of the second antenna of the Protostracods!

It is quite impossible at present to carry out a homologization between the joints of the endopodite in all the groups of the Ostracods; we get no help at all from the characters of bristles and muscles.

If, looking at these facts, we ask what is the number of joints that is to be taken as the most primitive for the endopodite, whether this branch was originally characterized by two, three, four or five joints, I think we shall be compelled to acknowledge that this is a question we cannot yet decide with any degree of certainty.

The exopodite of the second antenna of the Protostracods is supposed to have been composed of a rather large number of joints, about the same as in the case of the recent Cypridinids, Halocyprids and Polycopids. No proof of this is given by G. W. MÜLLER. Among the recent Ostracods we apparently find nine joints constantly in all representatives of the three above-mentioned groups; the Cytherellids have a powerful, two-jointed exopodite; in all other Ostracods this branch has no joints and is more or less completely reduced. Thus from comparative morphology we cannot — at least at present — produce any facts that indicate with any degree of certainty the number of joints that is to be taken as the original one for this branch. Nor can any such facts be obtained from com-

parative embryology. It seems, however, to be by no means impossible, perhaps even rather probable, that G. W. MÜLLER was pretty near the truth when he assumed that the Protostracods had a nine-jointed* exopodite, perhaps of about the same type as in the recent Polycopids. The reasons that seem to me to support this are, first, that the forms which are now characterized by an antenna of this sort, Cypridinids, Halocyprids and Polycopids, are in several respects certainly to be considered as the most primitive Ostracods, and, secondly, that the agreement in structure in these groups is altogether too great to justify us in assuming a convergence, in the case of an organ of so complicated a structure as this branch. At any rate the ancestral forms of these three groups probably had a similar exopodite on this limb.

The only statement about the second antenna of the Protostracods that we can make at present with almost complete certainty, is, according to my opinion, that it possessed a well-developed protopodite and a comparatively strong exopodite and endopodite.

We ought perhaps to note the great resemblances there is between this limb in the Cytherellids and the type that is presumably to be considered as the original one for the two following limbs, the mandible and the maxilla. Perhaps this indicates that the second antenna of this group represents a comparatively primitive type.

Was the endopodite in the males of the ancestral forms of Cypridinids, Halocyprids and Polycopids developed as a seizing organ, as G. W. MÜLLER has assumed? In the recent Cypridinids the whole of the end joint of the endopodite is pressed against the preceding joint in seizing. In the Halocyprids, on the other hand, the end joint has a process in the shape of a seizing arm, which issues proximally on the joint. The males of the Polycopids do not have the endopodite developed as a seizing organ; whether the wart-like process near the point of the endopodite which is found in this group (cf. G. W. MÜLLER, 1894, pl. 7, fig. 10) is homologous with the seizing arm in the Halocyprids, as G. W. MÜLLER has assumed, I must leave undecided; there is no certain proof of this homologization. G. W. MÜLLER does not give any and I have not found any myself. In the face of these facts — that the Polycopids, in several respects presumably the most primitive of these three groups, do not have this branch developed as a seizing organ and that the seizing function has been carried into effect in different ways in the Cypridinids and the Halocyprids — one must say that this assumption of G. W. MÜLLER's is to be considered as rather uncertain.

Mandible.

Mandible: — G. W. MÜLLER's assumption that this limb in the Protostracods was composed of two protopodite joints and three endopodite joints seems fairly probably;

* G. W. MÜLLER points out, 1894, p. 36 that „manche Arten weisen darauf hin, daß die Zahl ursprünglich größer war *(Philomedes)*". A careful study of some forms of this genus has convinced me that the chitinous structures on the end-joint of this branch (of the males), to which this writer refers, cannot probably be explained as traces of a tenth joint. In addition it is to be noted that, even if the genus *Philomedes* originally had a ten-jointed exopodite on this limb, it is obvious that we have no right, because of this, to conclude that the Protostracods originally had ten joints.

at least there seem to be no facts that are definitely against it. A greater number of joints do not appear in any forms; a two-jointed protopodite and a three-jointed endopodite occur in the most widely separated groups viz: Cypridinids, Halocyprids, Cyprids, Nesideids, Cytherids and Cytherellids. A smaller number is found in the Polycopids and in *Darwinulidae*. No trace of a procoxale has yet been observed in any recent forms; it is, however, not quite impossible that such a joint existed originally. Nor does there seem to be anything of importance to add with regard to this author's assumption about the endites on this limb. A powerful endite is found on the coxale in almost all groups. Without drawing any conclusions from this, I wish, however, to point out here that an endite or indications of such a process on the basale is found not only in Halocyprids and Polycopids but also in Asteropids and *Philomedes* as well, and in the Cypridinids, where traces of such an endite can also be observed, these traces are most strong in forms which are presumably to be considered as primitive *(Crossophorus)*; cf. the remark on the group *Cypridiniformes* below. On the other hand there seem to be no reasons that support the assumption that the palp in the Cypridinids is of a more primitive type than in other forms because of its size. The group *Polycopidae*, which is presumably in several respects rather primitive, is characterized by a very short mandible. Might not this fact be considered to support an assumption that the elongated mandible palp in Cypridinids and Halocyprids represents a secondary type? The assumption of a short mandible or at any rate of a moderately long mandible as being the original one in the Ostracods seems to me to be supported by the fact that in a number of forms in this group the mandible has been developed as the most important crawling limb on the anterior part of the body, while in others the endopodite of the second antenna has been developed for this function. It seems to me that the easiest way to explain this phenomenon is by assuming that in the Protostracods both the mandible and the endopodite of the second antenna were relatively short. With regard to the exopodite of this limb G. W. MÜLLER makes no assumption, as has been pointed out before. In the recent Ostracods this branch is always very small; in a number of forms it is peg-like, unjointed and almost bristleless; in others it is quite absent. It seems to me fairly probable that this branch was comparatively small in the Protostracods; on the other hand it seems to be more difficult to say anything certain about its type. As to whether the protopodite had an epipodial appendage is very difficult to decide; it may be best to leave this question open.

After having discussed the problem of the mandible of the Protostracods G. W. MÜLLER put forward the question as to why the endopodite of the second antenna had been developed into a powerful crawling leg in Cyprids, Darwinulids, Nesideids, Cytherids and Cytherellids; would it not have been more probable, he asks, for this function to have been taken over by the mandibular palp in these groups as in the Cypridinids? In answer to this question this author writes as follows, p. 194: „So auffallend ähnlich die Verwerthung des Mandibulartasters bei den Cypridiniden und der 2. Antenne bei den *Podocopa* (natürlich abgesehen vom Schwimmen bei letzteren) ist, so existirt doch ein wesentlicher Unterschied: bei den einen haben wir es mit einem Grabfuß, bei den anderen mit

einem Schreitfuß (ursprünglich sicher überall) zu thun. Der erstere muß kurz und gedrungen sein, entsprechend dem großen Widerstand, den er zu überwinden hat; der zweite soll lang gestreckt sein. Die Mandibulartaster hätte die heute von der 2. Antenne ausgeübte Function nicht übernehmen können, ohne eine Streckung und besonders ohne eine Verschiebung seines Ansatzpunktes zu erleiden, die mit seinen Beziehungen zur Nahrungsaufnahme unvereinbar gewesen wären." It does not seem to be going too far if we say that this statement has no scientific value whatever. To illustrate the statement that the mandibular palp in the Cypridinids must, on account of its digging function, be „kurz und gedrungen", I may, in the first place, refer here to G. W. MÜLLER's own statement, 1894, p. 47: „Wenden wir uns zum Taster, so verdient in erster Linie Erwähnung sein großer Umfang und seine freie Beweglichkeit, beides entsprechend der großen Rolle, die er für die Bewegung spielt, wonach man die ganze Mandibel als Kieferfuß, Kinnbackenfuß (DANA) bezeichnet hat", and, secondly, to the figures that have so far been given for these limbs. If, for instance, we compare the mandible of *Cypridina mediterranea* (G. W. MÜLLER, 1894, p. 45) with the second antenna of *Eucytherura gibbera* (G. W. MÜLLER, 1894, p. 35) we seem to be compelled to admit that the former is at least as elongated and slender and fitted to be a crawling limb as the latter. That the mandible could not be developed as a crawling limb except after a forward displacement of its point of attachment had taken place seems to be a statement that it is very difficult for G. W. MÜLLER to prove. For further details I need only refer here to what has been pointed out above (under the mandible) with regard to this matter.

Maxilla. Maxilla: — In the case of this limb too there does not seem to be anything of importance to remark about the assumption put forward by G. W. MÜLLER. The maxilla found in a number of forms of the family *Polycopidae* is presumably of a very primitive type. In any case, as will be seen from p. 31 of this treatise, the maxillae in Cypridinids and Halocyprids may fairly naturally be derived from the simply built type of maxilla that is found in *Polycopsis serrata* G. W. MÜLLER (cf. G. W. MÜLLER, 1894, pl. 7, fig. 51; reproduced in the present work, fig. III: 1). An epipodial appendage was probably developed on the coxale; about the occurrence of this organ on this limb see above.

In passing I wish to point out here that it does not seem to me improbable that the mandible and the maxilla were of about the same type in the Protostracods; they were probably moderately long, with powerful protopodites, and exopodites and endopodites with rather few joints. It is not impossible that they had three more or less distinctly separated protopodite joints, a two-jointed exopodite and a three-jointed endopodite. The second antenna may also have been of about the same type (of course apart from the fact that the two first-named were possibly provided with endites), but this assumption seems to me more uncertain than the former one; cf. p. 82.

Fifth limb. Fifth limb: — There seems to be greater uncertainty with regard to the structure of this appendage in the Protostracods than with regard to the preceding limbs.

In the recent Ostracods this limb shows very different types. In the Cypridinids — I leave out of consideration here the family *Asteropidae*, which is certainly very much metamorphized, and also the family *Sarsiellidae*, in which this limb is

presumably to be considered as having undergone a secondary simplification — it is of the foliaceous type. Its protopodite, which dominates somewhat over the exopodite, is broad and powerful, in most cases more or less distinctly two- or three-jointed and is closely joined to the body; each of the three protopodite joints is armed on its inner edge with a short but powerful endite. On the outside of the procoxale-coxale part of the protopodite there is an epipodial appendage that is developed into a very large and powerful vibratory plate. The exopodite has in most cases four or five joints; of these joints the two proximal ones are in most cases very strongly chitinized and are each provided on the inner edge with a low, but powerful, endite, armed with powerful bristles and teeth; the following two or three exopodite joints differ in most cases very considerably from the preceding ones in their structure, as they are very slightly chitinized and their bristles are most frequently rather soft and plumous; the end joint has a somewhat varying number of bristles. There is no endopodite on this limb. In the Halocyprids the protopodite of this limb is moderately large and sometimes has two joints; the boundary between these two joints is, however, rather weakly developed; the protopodite is somewhat less closely united to the body than in the preceding family; the basale has only one or two very small endites. On the outside of the procoxale-coxale part of the protopodite there is an epipodial appendage that is developed as a vibratory plate; this is somewhat smaller than in the preceding family. The endopodite is developed as a short, unjointed, powerful masticatory process. The exopodite is elongated and rod-shaped, with three or four joints (*Thaumatocypris* has four joints, all the other forms only three), its distal joint is small and has three bristles. In the Polycopids the protopodite is very powerful and dominates very strongly over the exopodite and the endopodite; in most cases it is more or less distinctly three-jointed, without endites. On the outside of the procoxale-coxale there is a rather large vibratory plate, the epipodite. The exopodite and endopodite are short, verruciform, unjointed, the exopodite has a somewhat varying number of distal bristles. In *Cypridae*, *Darwinulidae*, *Nesideidae* and *Cytheridae* we find a fifth limb that reminds us very much of this appendage in the Halocyprids. The protopodite is unjointed; in most cases it is much more free than in the preceding groups. The endopodite is sometimes developed as a more or less powerful, unjointed, masticatory process; often, however, it is more or less completely reduced. The exopodite is more or less elongated and has at most four joints, e. g. in *Macrocypris*, often three joints and sometimes two or one; in many forms it has three bristles distally, in others only one or two, but the evidence seems to show that three bristles is the original number for these families. The protopodite sometimes has a fairly well-devoloped epipodial vibratory plate, but this organ is often more or less completely reduced. *Cytherellidae* (in the male): The protopodite is unjointed, the endopodite is developed as a rather long, unjointed process for introducing the food into the mouth. The exopodite is elongated, three-jointed; its end joint is small and has only two bristles. The epipodite, the vibratory plate, is well developed and large.

Which of these types is the most primitive?

Most investigators of this subject assume that the foliaceous type that we find in the Cypridinids is the most primitive. On the other hand G. W. MÜLLER assumes, as we

see above, that the Protostracods had a fifth limb of about the same type as that of the recent genus *Macrocypris*, but with a well-developed vibratory plate on the protopodite. It seems to me very difficult to decide with certainty which of these views is correct. On the one hand I consider it by no means impossible that the foliaceous type in the Cypridinids may be original; this assumption agrees, of course, with the hypothesis that is almost universally adopted nowadays, namely that the foliaceous type is the original one for this limb in the *Crustacea* and that the rod-shaped limb is a secondary type developed from the foliaceous one — in most cases *via* the biramous stage. On the other hand I think it far from impossible that G. W. MÜLLER is nearest to the truth and that the foliaceous type is of a secondary nature in the Cypridinids, that in this group this limb was shortened in connection with its development as the most important or at any rate one of the most important masticatory organs. It is obvious that G. W. MÜLLER based his assumption on the agreement found between the fifth limb in the Halocyprids on the one hand and this appendage in Cyprids, Darwinulids, Nesideids and Cytherids on the other. This agreement is certainly striking, but this is such a relatively simple organ that I can by no means consider it quite impossible that the resemblance is due to convergence. See also below, the sixth and the seventh limbs.

It is possible, however, that the foliaceous type is the original one and that the rod-shaped type was developed from it, without it being necessary to assume that the resemblance between the fifth limb in the Halocyprids and the Cyprids, etc. is necessarily the result of convergence. This presupposes, however, that the ancestors of the Cyprids, Darwinulids, Nesideids and Cytherids branched off from the ancestors of the Halocyprids after the latter had been differentiated from the ancestors of the Cypridinids.

With regard to G. W. MÜLLER's assumption that the original number of joints on the exopodite* of this limb was four I only wish to point out that this is partly based on presumably incorrect homologizations. This writer states that the Cypridinids have four joints on this branch; in doing so he counted the basale of the protopodite as the first endopodite joint, the first and second joints of the exopodite as joint no. 2; on the other hand this writer has not paid attention to the fact that there is sometimes an additional joint distally of joint no. 4, sensu G. W. MÜLLER). According to this author the Halocyprids also have four joints on this branch; he arrived at this number by counting the endopodite as the first exopodite joint; cf. G. W. MÜLLER, 1894, p. 60. It is, however, to be noted that in one genus of this group, which was not known to this writer when he put forward the assumption discussed here, namely the genus *Thaumatocypris*, the exopodite has four joints; cf. G. W. MÜLLER, 1906 a, pl. VI, fig. 3. This is noteworthy, as this genus is in many respects to be considered as the most primitive among the Halocyprids. With regard to the uncertainty of the homologization of this limb compare p. 54 above.

G. W. MÜLLER's assumption that this limb was developed as a seizing organ in the males of the ancestors of the forms which he groups together under the name of *Podocopa*

* Explained by G. W. MÜLLER as an endopodite.

seems to be quite unsupported. With regard to this it ought to be enough to point out that this limb is not developed as a seizing organ in two of these families, namely *Nesideidae* and *Cytheridae*, and that the sixth limb in the males of *Cytherella* even shows a closer resemblance to the fifth limb of the Cyprids than does their fifth limb.

It is possible that the position of the fifth limb of Cypridinids and Halocyprids, where it is placed far forward, is, contrary to G. W. MÜLLER's view, to be considered as original. This assumption of G. W. MÜLLER's is, of course, connected with his supposition that the limb corresponding to te second maxilla of other Crustacean groups has disappeared in the Ostracods.

Sixth limb: — There is the same uncertainty with regard to this limb as with the preceding one. The assumptions that the foliaceous type of the Cypridinids is original and that the rod-shaped type is the most primitive are opposed to each other in this case as well. The fact that with regard to this limb too there is a very great agreement between the Halocyprids on the one hand and Cyprids, Darwinulids, Nesideids and Cytherids on the other makes the assumption that the resemblance between these limbs is due to convergence seem very improbable. *Sixth limb.*

It seems to be impossible to make any detailed statement at present as to the cause of the disappearance of this and the following limb in *Polycopidae*. G. W. MÜLLER assumes that it was due to the smallness of these forms. It is to be noted that these limbs are also reduced in the Cytherellids, although these are comparatively large forms.

Seventh limb: — Contrary to the two preceding limbs the seventh one never has a foliaceous type in the recent Ostracods. In Cyprids, Darwinulids, Nesideids and Cytherids it is of about the same type as the fifth and sixth limbs; in the Halocyprids it is certainly short, but all the same it is rod-shaped; in the Cypridinids, the group in which the fifth and sixth limbs are of the foliaceous type, it is developed as a long, vermiform annulated appendage. (In the Polycopids and Cytherellids this appendage is, as we know, not found at all.) These facts seems to support G. W. MÜLLER's assumption that this limb was originally of the rod-shaped type: it was perhaps, as this investigator assumed, of about the same type as in the recent Cyprids. This fact may also perhaps be considered to support the assumption that the rod-shaped type was also original for the two preceding limbs. *Seventh limb.*

Was this limb developed as a crawling limb in the Protostracods or did it act as a cleaning organ? G. W. MÜLLER assumes, as we have seen above, that it was used as a cleaning organ; other investigators, e. g. G. ALM, 1915, assume that it only adopted this function later. Which of these views is to be considered as correct?

G. ALM puts forward the following reasons for his view (pp. 18—21): In the Nesideids and Cytherids this appendage is used as a crawling limb, not as a cleaning organ. In the Darwinulids it is possibly used as a cleaning organ, but probably, at any rate, this function is only to be considered as secondary, crawling being the most important function. In the Cyprids we find in the lower forms that this appendage, although developed as a cleaning organ, „nach ihrer Lage zu urteilen sowohl als Bein wie als Putzfuß anwendbar ist"

(cf. G. W. MÜLLER, 1894, p. 16), while in the higher forms it is exclusively a cleaning organ. In the Cypridinids this appendage is developed into a complicated cleaning organ; in the Halocyprids it certainly functions as a cleaning organ, but still it is considerably less suited to this function than in the Cypridinids. „Stehen nun, wie MÜLLER meint, die Cypridiniden entwickelungsgeschichtlich auf einer höheren Stufe als die Halocypriden, so würde dies in Bezug auf den Putzfuß bedeuten, daß dieser bei den höheren Formen mehr verändert und seiner Funktion besser angepaßt ist als bei den niederen." In other words in several groups this limb is not developed as a cleaning organ, in others it is most complete as a cleaning organ in the most metamorphosed forms. In both high and low Cyprids, in Nesideids, Cytherids and Halocyprids* it begins embryologically as a downward and backward pointing process; only in the Cypridinids does it point upwards from the beginning. In the Cyprids it is developed pretty far without its position being altered; only at a rather late stage is it bent upwards. On the other hand G. W. MÜLLER gives no reason for his view; nor does it seem to me possible at present to find any. We seem to be compelled for the present to adopt the view assumed by G. ALM, but is does not seem to me impossible that G. W. MÜLLER may be right.

The question of why the cleaning limb has been reduced in the Halocyprids is one that can scarcely be answered yet. At any rate G. W. MÜLLER's assumption that the reduction was connected with „des Aufgebens der Brutpflege" seems to me, however, impossible**, as this organ almost always or at least in most cases is as well developed among

* It is to be noted that this limb in the Halocyprids is often still kept pointing backwards and downwards even in the mature stage, with only its small end joint pointing upwards. It is often found in this position even in dead specimens. Sometimes its end joint also points downwards.

The function of the seventh limb.

** In this connection I should like to say a few words with regard to the function of this limb in Cypridinids, Halocyprids and Cyprids. H. E. STRAUS, the first author to investigate this appendage in the Cyprids, assumed (1821, p. 47) that it was used „à soutenir les ovaires". H. MILNE EDWARDS, one of the first authors to discuss the Cypridinids, assumed (1840), presumably influenced by H. E. STRAUS, that this pair of limbs functions as eggbearers; he calls them „pattes ovifères". Several succeeding authors, e. g. W. BAIRD, J. D. DANA, E. GRUBE and even C. CLAUS in his earlier works, accepted this assumption. W. ZENKER, in his work „Monographie der Ostracoden, 1854", pointed out, p. 17, that H. E. STRAUS's assumption could not be correct. „Die Eier aber brauchen keine Unterstützung, da sie von der Wandung des Eileiters und außerdem noch von der Chitinhaut bedeckt sind." This author assumed that this appendage served as a cleaning organ for „die große Kiemenplatte mit ihren gefiederten Haaren". F. MÜLLER, in his work of 1870, expressed the view that this limb functions as a cleaning organ in the Cypridinids as well. He writes on p. 257 as follows: „Beobachtet man eine lebende *Cypridina nitidula* oder eine *C. Agassizii* mit nicht zu undurchsichtiger Schale, so sieht man die geringelten Anhänge, die mit ihrem meist rechtwinklig abstehenden Borstenbesatz fast wie die Bürsten aussehen, deren man sich zum Reinigen von Glascylindern bedient, in fast ununterbrochener, lebhafter Bewegung. Einem Ringelwurm vergleichbar, der aus seiner Röhre weit vorgestreckt nach allen Seiten umhertastet, kriechen sie und biegen sie sich nach allen Richtungen; namentlich an den Kiemen und in deren Umgebung fegen sie und putzen sie fleißig hin und her. Mit den Eiern, die allerdings wenigstens bei *C. Agassizii* innerhalb der Schale der Mutter sich entwickeln, haben sie nichts zu schaffen. Sie sind bei beiden Geschlechtern in völlig gleicher Weise ausgebildet." The same observations were afterwards made by other investigators, e. g. G. W. MÜLLER, 1894, p. 72, for the Cypridinids, and I too have had occasion to verify them. As a further proof that we are here concerned with a cleaning organ G. W. MÜLLER (l. c.) states that in the genus *Sarsiella* he often found „den 1. Fuß des ♂ arg verschmutzt, ja, einmal war es auch die Athemplatte der Maxille und die hintere Körperhälfte"; we know that in the males of this genus the 7th limb is quite absent. In Cyprids too it has been observed that this appendage is, as it were, continually combing and cleaning. With regard to the Halocyprids G. W. MÜLLER pointed out, 1894, p. 73, that this limb carries out movements that closely resemble the cleaning movements of the corresponding appendage in the Cypridinids and he assumes that these movements have the same purpose here

males as females. As far as we know the males have nothing to do with the brood charge in the Ostracods. Moreover it is, as we know, developed as a cleaning organ among the Cyprids as well, a group which has no brood charge.

Does there exist a correlation between the development of the 5th and 7th limbs? Which factors have influenced the development of these limbs? (Some accessory remarks.

After having discovered that the development of the seventh limb as a cleaning organ in Cyprids and Cypridinids is presumably not to be taken as a result of common inheritance but that we are probably concerned in this case with a phenomenon of convergence, G. ALM, in his above-quoted work, puts forward the question as to why this appendage is not developed into a cleaning organ in the families *Nesideidae* and *Cytheridae*. On this point he writes as follows: „Was die soeben bemerkte Eigentümlichkeit der 1. und 3. Beinpaare betrifft, so ist zu bemerken, daß augenscheinlich eine gewisse Korrelation zwischen diesen beiden Extremitätenpaaren vorliegt. Ich halte es nicht für unmöglich, daß wir die Erklärung derselben in der Lebensweise und Nahrungsaufnahme der verschiedenen Gruppen zu suchen haben. Wenn man den Putzfuß als ein Reinigungsorgan betrachtet, was mir ganz sicher erscheint, darf man wohl annehmen, daß das Tier da, wo ein solches Bein auftritt, mehr dem Beschmutzen ausgesetzt ist, als in dem Falle, wo das 3. Bein keine Putzfunktion hat. Es ist da bemerkenswert, daß gerade bei den Cypriden das 1. Bein in Bezug zur Nahrungsaufnahme tritt, und da diese Formen gerne von kleinen toten Tieren und in Verwesung begriffenen Tieren und Pflanzen ihre Nahrung entnehmen, ist es leicht denkbar, daß bei der Nahrungsaufnahme kleine Teilchen der Beute umhergestreut werden und an den Körperseiten und Innenlamellen haften bleiben."

as well. But, he adds, the result seems to be very poor. „Der Theil des Korpers, welchen das Bein mit seiner Borste erreichen kann, also der Rücken über der Furca und die Innenseite der hinteren Schalenhälfte, ist nämlich annähernd glatt und so der Gefahr des Verschmutzens wenig ausgesetzt. Die benachbarten Athemplatten, für welche ein Reinigungsapparat am ersten nöthig scheint, kann aber das Bein nicht erreichen. Hält man eine *Conchoecia* in Wasser, in welchem feine Carminkörnchen suspendirt sind, so kann man sehen, wie sich bald Körnchen, verklebt durch das Secret der Drüsenzellen des Schalenrandes, zwischen die Strahlen der Athemplatten setzen. In einem solchen Fall, den ich genau beobachtete, reinigten sich die Athemplatten selber lediglich durch die eigene Bewegung; die Körnchen ballten sich zusammen, stießen sich ab, und die Platte war bald wieder rein, ohne daß das letzte Bein oder ein anderes eine direct reinigende putzende Bewegung ausgeführt hätte. In diesem Fall war eine Mitwirkung des fraglichen Beines auch schon dadurch ausgeschlossen, daß es sich mit seiner Spitze in einem Klümpchen des klebrigen Secretes, gemischt mit Carminkörnchen, das am Rücken saß, gefangen hatte und sich daraus trotz aller Anstrengungen nicht oder erst nach längerer Bemühung befreien konnte, nachdem die Athemplatten bereits ihren Schmutz selbständig abgestoßen hatten."

It seems presumably to be a case of a cleaning organ; at any rate I cannot offer any new explanation. But I should like to point out some facts which seem, in the first place, to support the above-quoted statement of G. W. MÜLLER about the Halocyprids, and, in the second place, perhaps to suggest that this appendage has some other function besides that of a cleaning organ. First it may be stated that on several occasions I came across Cypridinids with well-developed seventh limbs, but with their bodies very much covered with dirt. A more important fact, however, is that in the Cypridinids this appendage appears very late. According to what I found, *Philomedes globosa* goes through seven post-embryonal moults before it arrives at maturity. The seventh limb is not developed until the penultimate larval stage, when the larva has already attained two-thirds of the length of the mature specimen. During all this time the larva lives, like the mature female, digging in the sand and mud of the bottom. In spite of this it shows no sign of dirt; on the contrary it is as clean before the development of the seventh limb as after. I have found the same state of affairs in other Cypridinids. In the Cyprids too this limb obtains its definite shape very late and no difference can be observed with regard to the cleanliness of larvae and mature individuals. This state of affairs clearly shows, as far as I can see, that this limb is not absolutely necessary for the cleanliness of these forms. The fact that this limb is developed so late may perhaps indicate that it has a special function in connection with propagation. G. W. MÜLLER, 1894, p. 72, like L. LÜDERS, 1909, p. 110, points out its importance for keeping the eggs clean. „Diese Bedeutung, die es danach augenscheinlich für die Brutpflege hat, macht es in etwas verständlich, daß es beim ♂ von *Sarsiella* rudimentär geworden ist." But this can, of course, only be a secondary function, as in most forms this limb is as well or at least almost as well developed in males as in females.

The assumption that the fifth and seventh limbs are correlated to each other, that the latter has been developed into a cleaning organ when, owing to the development of the former as an masticatory organ, the breaking-up of the food had been intensified, seems to be open to criticism to a considerable extent. G. ALM seems, as a matter of fact, to have realized this, and his assumption is put forward very cautiously.

Let us first examine the family quoted, the *Cypridae*. The fifth limb in, for instance, a *Cypris* — or *Candona* — species certainly seems to help pretty considerably in the breaking up of the food, both directly by chewing and indirectly by holding the food fast and by pushing it in under the two anterior masticatory appendages. There are thus reasons that support the idea that in these forms, owing to the co-operation of the fifth limb in the process of chewing, the breaking of the food is intensified and that, in connection with this, a rather considerable increase of the defiling particles is produced. These forms thus seem to support G. ALM's statement. On the other hand, however, there is in this family a number of forms which decidedly contradict this assumption. Thus the masticatory part of the fifth limb in the genera *Pontocypris* and *Pontocypria* is sometimes not developed at all and often only slightly developed and is furnished with a few weak, often soft and plumous bristles (as examples may be mentioned *Pontocypris pellucida* G. W. MÜLLER and *P. pirifera* G. W. MÜLLER; the males of these species have about two to four bristles on the reduced endopodite of this limb; cf. G. W. MÜLLER, 1894, pl. 9, fig. 54 and pl. 10, figs. 23, 24). In these genera the fifth limb does not take any part — or at any rate only a very slight one — in holding and breaking up the food; we have not, even in the forms whose fifth limb is characterized by a somewhat greater number of bristles than in the species mentioned above, any well-grounded cause to assume any essential increase of the small defiling particles produced by mastication. In the males of the genus *Erythrocypris*, e. g. those of the *E. pallida* G. W. MÜLLER (cf. G. W. MÜLLER, 1894, pl. 11, figs. 43, 44) the most projecting part of this limb is quite without bristles; in the case of these forms any discussion of the use of this appendage in the service of mastication may be considered superfluous. Although in these genera it is thus impossible to think that we are justified in assuming that any real increase in the number of the small defiling particles is produced by the activity of the fifth limb, yet the seventh limb is in them apparently developed into an effective cleaning organ, at any rate as effective as in the genera *Cypris* and *Candona*. Although a certain difference may be observed in different forms with regard to the development of the seventh limb (the degree of pectination of the end bristles), this has no connection at all with the development of the bristles on the anterior side of the fifth limb. In the genera *Argilloecia* and *Macrocypris*, and to a still greater extent in *Paracypris* the masticatory part (the endopodite) of the fifth limb is furnished with numerous bristles and is also developed as a long branch pointing forward (cf., for instance, G. W. MÜLLER, 1894, pl. 12, fig. 41, 42); in these genera this limb seems to help considerably in intensifying mastication and thus possibly in increasing the number of the small defiling particles as well. But the seventh limb is apparently not so well developed as a cleaning organ in these forms as in the preceding genera; for instance it has no pectination at all on the end bristles. In *Paracypris rara* (G. W. MÜLLER), a form with a very powerful masticatory part on the fifth limb, we even find a seventh limb that is almost completely without

such characters as distinguish a cleaning limb from a crawling leg (cf. G. W. MÜLLER, 1894, pl. 12, fig. 49). If we turn to the family *Darwinulidae*, which is closely related to the Cyprids, we find that although the fifth limb has been developed as a presumably rather effective masticatory organ, the seventh limb is not differentiated as a cleaning organ but has entered the service of locomotion. Nor do the conditions in the Cypridinids support the assumption put forward by G. ALM. The fifth limb in, for instance, the genera *Cypridina* and *Philomedes* certainly helps considerably in breaking up the food, even to a far greater extent than in some Cyprids; this idea is supported by the extremely powerful musculature and armature of this appendage. As in these genera the seventh limb is developed as a presumably effective cleaning organ one would think, of course, that the conditions in these genera support G. ALM's hypothesis, but, as we know, the fact is that in these genera the mandible does not at all help or at any rate only helps very slightly in the breaking up of the food, which quite makes up for the development of the fifth limb as a masticatory organ. The *Asteropids* are characterized by a method of taking up the food that is quite unlike that of other Cypridinids. As we know, a rather strong current of water from front to back is produced in the Cypridinids by the movements of the vibratory plate on the fifth limb; this is for respiration — as is generally assumed and appears very probable. While in most Cypridinids this stream is allowed to pass freely along between the shell and the body without losing any of the organic and inorganic little particles that naturally accompany it, whirled up from the bottom, this is not the case in the Asteropids. As has been described in another place in this treatise, the limbs of the mouth have been differentiated in a very strange way in these forms. The maxilla has been developed into a sort of baleen-like organ, which, with its epipodial appendage and its long, fine ventral bristles fills the anterior opening of the canal through which the respiratory water has to pass. By means of these baleens the water that runs through is cleaned of a great many of the defiling particles; a number of these particles constitute the food of these forms. The water that, after passing the maxilla, continues backwards between the shell and the wall of the body, is thus presumably much cleaner than the respiratory water in other Cypridinids. It is true that the fifth limb is developed as a mouth organ in these forms, but it does not act as a masticatory appendage and thus does not increase the number of the defiling particles. The food is not broken up at all and the respiratory water that passes is cleaned from small defiling particles before it penetrates into the part that is cleaned by the seventh limb. In spite of this this limb is well developed as a cleaning organ in these forms. The Halocyprids have in their mandible and maxilla quite as powerful masticatory organs as any representative of the family *Cypridae*; in addition they have a rather powerful masticatory part on the fifth limb. In spite of this their cleaning limb is very much reduced; cf. the remark above, p. 89. Finally it ought to be noted that among the families whose fifth and seventh limbs are developed as typical crawling legs there are certainly forms that have more powerful and more intensive mastication than a number of forms whose seventh limb is developed as a cleaning organ and whose fifth limb helps more or less in intensifying the mastication. The methods by which the Cytherellids and the Polycopids take up their food are too little known

for these families to be taken into consideration in this connection. See also the remark above, p. 89.

From what has been shown above it seems to follow that G. ALM's assumption that the seventh limb was developed as a cleaning organ in the cases where the mastication had been intensified by the development of the fifth limb as a masticatory organ cannot be maintained. Nor have I succeeded in establishing any condition of correlation between the development of the masticatory parts of the mandible and maxilla on the one hand and the seventh limb on the other.

Does there not exist, however, a certain correlation between the fifth and seventh limbs? Or, as I should prefer to put the question: Which factor or factors have exerted an influence in the development of these appendages? What is more natural in dealing with this problem than first to try to discover whether this development has not been connected with the method of locomotion of these animals?

Let us once more take the case of the family *Cypridae* first. If one observes a *Cypris* in motion on the bottom one can easily discover that with the help of the first antennae, which strike regularly upwards and backwards, and the second antennae, which either strike downwards and backwards or carry out crawling movements, it seems rather to glide than to crawl heavily over the sub-stratum. Owing to the natatory movements of the first and second antennae the representatives of this genus naturally have less need of effective assistance from the posterior limbs for locomotion. This applies, of course, still more strongly to the powerful swimmers in this family, e. g. the genera *Cypria* and *Cyclocypris*. The same method of locomotion as in the genus *Cypris* is found in a number of representatives of this family; I need only mention here as examples the genera *Pontocypris*, *Erythrocypris* and *Iliocypris*. G. W. MÜLLER writes about the representatives of the sub-family *Iliocyprinae* in „Deutschlands Süßwasser-Ostracoden" 1900, p. 90, that besides freely swimming they generally „sich rasch gleitend über den Grund bewegen". There are, however, representatives of *Cypridae* that are unable to swim at all; I need only mention here as examples the genera *Candona* and *Macrocypris*, as well as the females and partly the males too of the genus *Argilloecia*. But this does not exert very much influence on what might be called the principle of crawling, as these forms also have rather long, stiff bristles on the first antenna — though not so long as in the swimming species. These forms use the second antenna and the sixth limb in crawling. This movement would, however, be very heavy and uncertain unless in these genera too the first antenna struck upwards and backwards in the same way as in the swimming forms and so help very much both in keeping the animal in equilibrium and in propelling it forward. Thus in all the forms belonging to the family *Cypridae* the first antenna is used in crawling in a way that gives both comparatively great rapidity and also good stability to the movement.

The mode of life of the family *Darwinulidae* is too little known for us to use it in this argument. It has presumably about the same method of locomotion as the Nesideids and Cytherids, so that I shall only refer here to what is said in connection with these families.

The family *Cytherellidae* is also very little known oecologically; they are slow, digging forms without any power of swimming. The digging life has to a great extent left its impression

on the two pairs of antennae. These have been developed into real small digging shovels. If one leaves the furca out of consideration, these limbs are on the whole to be considered as the only locomotory organs.

The families *Nesideidae* and *Cytheridae* are, as G. W. MÜLLER wrote in his monograph. 1894, p. 16 „vollständig an den Grund gefesselt und durchaus unfähig zum Schwimmen". They are, however, not slow like the Cytherellids, but in most cases crawl about fairly rapidly on the bottom or on water plants. Unlike the Cyprids they obtain no help or only very slight help from the first antenna in crawling. In a number of forms, e. g. *Cythere*, *Cythereis*, *Krithe*, etc., this antenna is used chiefly for thrusting obstacles to the side, e. g. grains of sand, etc.; in other forms, e. g. *Nesidea*, *Sclerochilus* and *Paradoxostoma*, etc., it is to be regarded almost exclusively as a sensory organ. But whatever may be the case, this limb does not help to produce a stable and comparatively easy crawling movement in these two families. Looking at it from this point of view it is not surprising that in these families the limbs that have a rather slight significance or none at all in locomotion in the Cyprids, namely the three posterior ones, have been more differentiated as locomotive organs. The fifth limb has been lengthened and does not take any part in mastication. The seventh limb is a typical, elongated crawling leg and does not point upwards as in the Cyprids. The second antenna in these forms is one of the most important crawling organs; it is this appendage especially that draws the body forward. As G. W. MÜLLER has pointed out, this limb has in the Cytherids a powerful spinning gland, opening out on the point of the exopodite. From this gland a fine thread of a sticky, quickly stiffening, substance is pressed out (as in spiders) and is attached to the sub-stratum. These threads are, as G. W. MÜLLER has shown, of great importance in locomotion, especially in climbing down steep and smooth objects, e. g. algae, etc., as it is on them that the posterior limbs obtain a hold during climbing. It is obvious that there must be several pairs of legs to keep the animal safely attached during the alternate seizing and releasing that takes place while climbing along these steep objects and to prevent it from falling outwards and sinking to the bottom, as these animals have not, as has been pointed out above, any first antenna, like that of the Cyprids, which by means of its natatory movements is able to keep the body pressed against the sub-stratum. The three posterior limbs can, however, be also used in crawling on horizontal sub-strata. They are, as we know, built in such a way that they might seem to be best fitted for a backward crawling movement, a structure that is presumably to be considered as an adaptation to the climbing movements described above. SØREN JENSEN* even assumed that they were situated in a direction quite the opposite of that which they actually have and he accordingly also assumed that they were used as ordinary crawling legs. After a correct idea of their direction was obtained, the idea of their function was also altered. G. W. MÜLLER, for instance, writes in 1894, p. 16: „Sie dienen zum Anklammern. Auch hier scheinen sie gewöhnlich nicht zum Fortschieben benutzt zu werden. Doch ist es kaum möglich, sich darüber Gewißheit zu verschaffen." G. ALM, in his work quoted above, describes how the Cyprids use their sixth limb in crawling. The same crawling movements are carried out by the three posterior limbs of the Cytherids

* „Biologiske og systematiske Undersøgelser over Ferskvands Ostracoder". Naturh. Medd. Kjøbenhavn

and Nesideids, a fact that I observed myself and that is by no means difficult to verify. In this mode of crawling too it seems expedient for several pairs of legs to co-operate.

The Cypridinids pass their lives — provided they are not exclusively swimming or digging forms — partly in swimming about freely in layers of water just above the bottom, partly in digging in the sand and mud of the bottom. „Zu einer eigentlich kriechenden Bewegung auf dem Grund sind die Cypridiniden vermöge des Baues ihrer Gliedmaaßen durchaus unfähig; ich habe sie denn auch niemals in der Gefangenschaft sich in ähnlicher Weise bewegen sehen." (G. W. MÜLLER, 1894, p. 14.) In swimming and in digging the three posterior limbs have no function to fulfil; swimming is carried out exclusively by the second antenna, digging, as in the *Cytherellidae*, by a couple of the anterior limbs (the mandible, sometimes the second antenna as well) and the furca.

The Halocyprids are exclusively pelagic forms; they swim only with the second antenna.

The Polycopids cannot crawl. They either lie still on the bottom or take short swimming trips to the layers of water just above the bottom. They swim with the first and second antennae and the maxilla; as in the case of the Halocyprids, the other limbs are not used in locomotion.

We thus find that the fifth and seventh limbs do not take part or take only a very slight part in locomotion in the case of freely swimming forms or in crawling forms in which the crawling motions are helped by the more or less powerful upward and backward natatory movements of the first antenna. In crawling forms whose first antenna does not take part in locomotion the fifth and seventh limbs are developed as crawling legs.

I do not mean by this, of course, that the method of locomotion was the only factor that influenced the development of the two limbs just mentioned. Presumably, though not certainly, other factors — both internal and external — have, as G. ALM also supposes, cooperated; among such presumable factors may be mentioned the nature of the sub-stratum on which these animals live and presumably the nature of their food as well. In any case the method of locomotion must be considered to have been an important factor.

After this excursus I return to my discussion of G. W. MÜLLER's exposition of the organization of the Protostracods.

Vibratory plates.

I have nothing to add about his assumption as to the vibratory plates; it is not impossible that in this G. W. MÜLLER has come very near to the truth, but it is by no means proved.

Furca.

G. W. MÜLLER assumes that the furca of the Protostracods was of about the same type as this organ in *Conchoecia*. This seems presumably to be a some premature assumption.

Comparatively short and powerful furcal lamellae, armed with several strong claws, i. e. about the same type as in *Conchoecia*, is found in Cypridinids, Polycopids and most of the Halocyprids. In the other Ostracods we find furcae of very varying types. A number of forms, viz. Cytherids, have a very short and weak furca with a few weak bristles. Others, viz. Cyprids and Nesideids, are characterized by relatively long and narrow furcal lamellae, armed with a comparatively small number of bristles and

claws. Finally the Cytherellids have, it is true, rather short and broad and powerful furcal lamellae, armed with rather numerous claws, but the furca in these forms is of quite a different type from that found in Cypridinids and Halocyprids.

Which of these types is to be considered the most primitive?

I consider it rather improbable that the very small furca in the Cytherids represents a primitive condition. Presumably a reduction has taken place in these forms (possibly in connection with the powerful development of the posterior limbs). The different development and type of the furcal lamellae and the great variation in the number and development of the furcal claws in the other groups seem to indicate that, in spite of the fact that it presumably had comparatively well developed lamellae, the furca of the Protostracods was, all the same, very slightly differentiated; presumably it was armed with only a few claws. The following facts also seem to support this assumption. *Thaumatocypris*, which is, in many respects presumably the most primitive genus among all Halocyprids, has a furca that consists of two relatively short, broad and powerful lamellae — like that of other Halocyprids. Each of these lamellae is armed with only two claws, situated distally; behind these claws there is only a number of short spines. What perhaps strikes the observer of this furca more than anything is its great resemblance to the furca in a closely-related group of animals — the *Cladocera*. Without going so far as to say that this furcal type is the most primitive, I wish, however, to point out one fact that may perhaps be considered to point in this direction. In investigating the post-embryonal development of the Cypridinids I observed that both in the sub-genera *Doloria* and *Vargula* and in *Philomedes* the youngest freely living larval stage is characterized by a furca consisting of two relatively short and broad, but powerful, lamellae; each of these lamellae is armed distally with two rather long and powerful claws, behind which there follow a number of short and weak spine-like claws; cf. the special part of this work, fig. 21 of *Philomedes globosa* and fig. 14 of *Cypridina (Doloria) pectinata*; only during the larval stages that immediately follow do these claws grow, so that in these stages the transition between the distal and the proximal claws becomes uniform. G. W. MÜLLER made the same observation (1894, p. 185) in the representatives of the Cypridinid group investigated by him, species of *Vargula*, *Philomedes*, *Pseudophilomedes*, *Sarsiella* and *Asterope*; cf., for instance, G. W. MÜLLER's figure of a larval furca of the genus *Asterope*, 1894, pl. 34, fig. 53. C. CLAUS, 1893, showed that the same condition is also characteristic of the Halocyprids (p. 286). „Das jüngste der beobachteten Stadien, leider nur ein einzigesmal aufgefunden . . . . besitzt nur 2 Paare von Furcalklauen." During the first freely living larval stage these forms thus have a furca whose type differs very much from that of the mature individuals, but which shows, on the other hand, a comparatively close agreement with the furca in *Thaumatocypris*. — It is to be noted that the genus *Thaumatocypris* was unknown to G. W. MÜLLER in 1894.

As will be seen from what has preceded, G. W. MÜLLER does not say anything about the sexual organs of the Protostracods. This problem has rather great difficulties. On account of the conditions in the recent Ostracods and closely related Crustacean groups, it seems to me most probable that both the testicles and the ovaries in

the Protostracods consisted of two simple sacks situated in the posterior part of the body; from each of these sacks there was a simply constructed duct, opening out ventrally just in front of the furca; on the other hand it seems to me to be quite uncertain whether the sexual ducts opened outwards with a simple or a paired orifice. In the males the posterior pair of legs was used in copulation and was developed into the two penes. The fate of this pair of legs in the females is uncertain; there is possibly a remains of them in the genital verrucae. Among the recent Ostracods the most primitive conditions seem to be found in a number of Cypridinids, possibly, for instance, in *Philomedes* and *Asterope*.

[illegible]

Did the Protostracods have a rod-shaped organ?

G. W. MÜLLER does not make any statement on this point either. C. CLAUS expresses himself (1876, p. 97) in such a way that one can scarcely doubt that he considered that they had. I scarcely think, however, that they had. Among the recent Ostracods this organ is absent not only in Cyprids, Darwinulids, Nesideids, Cytherids, but also in Cytherellids and Polycopids, which we are accustomed to consider as being in many respects rather primitive and in the genus that is in several respects presumably the most primitive among the Halocyprids, namely *Thaumatocypris*. Only in the Cypridinids and most of the Halocyprids is it developed. I myself have only had an opportunity of investigating one species of *Polycopidae*. This was characterized by two bristles, situated rather near each other on the front of the head, on each side of the place where the rod-shaped organ is situated in the Cypridinids. Do these bristles correspond to the similarly situated bristles in other lower Crustacean groups? Is this a primitive stage? It seems to me by no means impossible that this is the case. It seems difficult to assume that a rod-shaped organ existed originally and was then completely reduced in all these forms. The fact that this organ is absent in the most primitive genus of the Halocyprids even seems to indicate that the appearance of this organ in Cypridinids and Halocyprids is not, as C. CLAUS has assumed, the result of common inheritance, but that we have here once more a phenomenon due to convergence.

[illegible]

This investigation has thus shown that while it is true that we can say with some degree of certainty in the case of a number of characters that they are original, our whole knowledge of the organization of the Protostracods is very incomplete and uncertain, a good deal more uncertain than one would imagine from G. W. MÜLLER's exposition.

[illegible] classification of the [illegible] Ostracods [illegible] G. W. [illegible]

G. W. MÜLLER gives the results of his investigation of the mutual relationships of the recent Ostracods in his monograph of 1894, pp. 188—191.

The most important of these results is that the recent Ostracods are to be divided into two main natural groups, sharply divided from each other, *Myodocopa* and *Podocopa*. To the former belong Cypridinids, Halocyprids and Polycopids, to the latter Cyprids, Darwinulids, Nesideids, Cytherids and Cytherellids.

The view that these animals can be divided into two natural, sharply differentiated — „scharf getrennte" — main divisions is, as is shown above, decidedly opposed to the views of C. O. SARS and C. CLAUS. As a matter of fact G. W. MÜLLER is almost alone in this view.

Can the two main groups Myodocopa and Podocopa be maintained?

Is it possible to maintain these two main groups?

Myodocopa, as this group is taken by G. W. MÜLLER, is, according to the same author, 1894, pp. 188—189, characterized by a rostral incisur on the shell, the great number of joints on the exopodite of the second antenna, the large, mostly very mobile, mandibular palp, the absence of a large vibratory plate on the maxilla, the presence of one on the following limb and finally by the type of the furca. This author diagnoses this group as follows in his work of 1912: „Schale meist mit Incisur am Vorderrande; Ventralrand meist gewölbt. Stamm der 2. Antenne umfangreich, schinkenförmig, ungegliedert; Exopodit gestreckt, meist 9-gliedrig; das 1., selten 1.—3. Glied des Exopodit gestreckt, die folgenden Glieder (mindestens 6) sehr kurz, einander ähnlich, jedes mit 1 umfangreichen, meist gefiederten Borste, das Endglied mit mehreren Borsten; Endopodit mit 3 oder weniger Gliedern, meist viel schwächer als der Exopodit, beim ♂ gewöhnlich als Greiforgan entwickelt, bisweilen in beiden Geschlechtern rudimentär. Maxille mit meist deutlich 3-gliedrigem Taster, ohne Atemplatte. Das 1. Thoraxbein steht fast durchweg im Dienste der Nahrungsaufnahme, auch die Glieder seines Endopodit können zu Kaufortsätzen werden; sein Stamm, in großem Umfange mit den Seiten des Körpers verschmolzen, trägt eine umfangreiche Atemplatte. Das 2. und 3. Thoraxbein zeigt außerordentlich verschiedene Formen; beide können fehlen. Ein bürstenförmiges Organ fehlt fast stets. Furca stets wohl entwickelt, breit, lamellös, mit wenigstens 3 starken, dornartigen Anhängen."

Podocopa, in the sense in which it is taken by G. W. MÜLLER, is, according to this writer, 1894, p. 189, characterized by the fact that the ventral margin of the shell is flattened, by the structure of the second antenna, above all by the reduction of the exopodite and the position of this limb, and finally by the vibratory plates on the mandible and the maxilla. This writer diagnoses this group as follows in his work of 1912: „Schale stets stark verkalkt, niemals mit Incisur oder Rostrum. Ventralrand abgeflacht, oft mit Einbuchtung, ausnahmsweise konvex. Die 2. Antenne entspringt zu beiden Seiten der Oberlippe auf einem Fortsatze, der von manchen Autoren als 1. Stammglied betrachtet, hier aber nicht zur Antenne gerechnet wird; sie besteht aus dem ein- selten zweigliedrigen Stamme, dem höchstens 4-gliedrigen Endopodit und dem Exopodit, welcher ausnahmsweise aus 2 deutlichen, borstentragenden Gliedern zusammengesetzt ist, meist nur als kleine, borstentragende Platte oder als einzelne Borste erhalten ist; das 1. Stammglied ist cylindrisch, in der Ruhe nach vorn und dorsalwärts gerichtet; es bildet in der Ruhe mit dem 2. Stammgliede und dem Endopodit oder beim Fehlen des ersteren, nur mit dem Endopodit einen meist scharf ausgeprägten, ventralwärts offenen Winkel; Endopodit meist gestreckt, terminal stets mit Klauen bewaffnet, im übrigen sehr verschieden gestaltet. Mandibel meist mit deutlich gezähneltem Kaufortsatze des Basalgliedes und höchstens 4-gliedrigem Taster, der selten ganz fehlt; sein 1. Glied trägt eine Atemplatte. Maxille mit 3 meist gestreckten Kaufortsätzen des Stammes und diesen ähnlich gestaltetem Taster, der selten 3-gliedrig, meist durch Verschmelzung des 1. und 2. Gliedes 2-gliedrig oder ungegliedert ist. Kaufortsätze und Taster können zum Teil oder vollständig verloren gehen; mit umfangreicher Atemplatte, welche radiär angeordnete, gefiederte Strahlen trägt, ein Teil derselben, und zwar in erster Linie die ventralen des Hinterrandes, seltener des Vorderrandes, sind häufig abweichend gestaltet und gerichtet. Das 1. Thoraxbein besteht aus dem ungegliederten Stamme, der bald seitlich dem

Rumpfe angeheftet und in großem Umfange mit ihm verbunden ist, bald mehr ventral entspringt und frei eingelenkt ist; derselbe trägt den nach vorn gerichteten, als Kaufortsatz dienenden Exopodit (?), welcher häufig mit dem Stamme verschmolzen oder ganz geschwunden ist; der hintere Ast (Taster), den ich als Endopodit bezeichne (obwohl die Deutung nicht sicher), ist da, wo die Gliedmaße als Hilfsorgan bei der Nahrungsaufnahme dient, beim ♀ kurz, tasterartig, selten 4-gliedrig, meist wenigergliedrig oder ungegliedert, beim ♂ als Greiforgan entwickelt, wobei die meist verschmolzenen 2.—4. Glieder als beweglicher Finger gegen das 1. Glied eingeschlagen werden können; der Finger kann mit dem Stamme verschmelzen; die Greiforgane sind meist auffallend asymmetrisch gestaltet. Wo die Gliedmaße nicht als Maxillarfuß dient, ist der Exopodit geschwunden, der Endopodit gestreckt, 4- oder 3-gliedrig, selten wenigergliedrig. Der Hinterrand des Stammes kann in beiden Gruppen eine Atemplatte tragen, die aber häufig der Rückbildung verfällt. Der Stamm des 2. Thoraxbeines weist bezüglich der Anheftung ähnliche Unterschiede auf wie der des 1. Beines; Reste eines Exopodit sind nicht nachweisbar; der Endopodit ist fast ausnahmslos nach hinten gerichtet, gestreckt, 4- oder 3-, selten wenigergliedrig; er trägt terminal eine große Klaue; eine Atemplatte findet sich nur sehr selten. Das 3. Thoraxbein zeigt bezüglich der Anheftung des Stammes ähnliche Unterschiede wie das 1. und 2. Bein; Reste eines Exopodit fehlen ganz; der Endopodit ist stets gestreckt, 4- oder 3-gliedrig; er ist als Schreitbein ventralwärts gerichtet, dem 2. oder 1. und 2. Thoraxbein ähnlich, oder als Putzbein dorsalwärts gerichtet; den Cytherelliden fehlt es ganz. Bürstenförmiges Organ auf die ♂ beschränkt, auch diesen fehlt es bei den Cypriden fast ganz; es steht bald hinter, bald zwischen, bald vor den Thoraxbeinen. Begattungsorgane des ♂ paarig, umfangreich. Furca von sehr wechselnder Form." — In the following discussion the terms *Myodocopa* and *Podocopa* are used in G. W. MÜLLER's sense.

Importance of the characters used by G. W. Müller.

How much value from a classificatory point of view can be assigned to these characters used by G. W. MÜLLER?

Shell.

Shell: — With regard to the rostral incisur, a character to which G. W. MÜLLER clearly attached great importance, we may note, first, that it is not common to all Myodocopids, being absent in *Polycopidae*, and secondly that the rostrum in Halocyprids seems, as has been shown on p. 71 above, not to be homologous with the corresponding organ in the Cypridinids. Nor can any importance be attached to the calciferous nature of the shell or the shape of the ventral margin. Presumably, as G. W. MÜLLER pointed out, the Protostracods had a calciferous shell enclosing the whole body; this is also the condition found in practically all recent forms, both *Myodocopa* and *Podocopa*. The shape of the ventral margin varies pretty considerably both in *Myodocopa* and *Podocopa*, even though on the whole it is more convex in the former group, more flattened or even concave in the latter; the shape seems, at least to some extent, to be connected with the mode of life; finally we must note that G. W. MÜLLER assumed that the convex ventral margin was characteristic of the Protostracods.

First antenna.

First antenna: — This appendage varies so much in structure both in *Myodocopa* and *Podocopa* that no attention can be paid to it from a classificatory point of view. It may be noted in passing that the first antenna in, e. g., *Thaumatocypris*, shows a greater

resemblance to this appendage in the Cyprids than to the corresponding organ in the other Halocyprids.

Second antenna. Second antenna: — It is true that this antenna issues at the same place „zu beiden Seiten der Oberlippe", but in other respects it shows rather far-reaching differences in *Myodocopa* and *Podocopa*. It is this organ, from the structure of which G. O. SARS has given the names to the two groups, that really seems to me to be the best support for G. W. MÜLLER's classification. There are, however, a number of facts that seem to deserve closer observation. According to G. W. MÜLLER, an important difference between *Myodocopa* and *Podocopa* is that in the former group a knee has been formed between the basale of the protopodite on the one hand and the exopodite and endopodite on the other, while in the latter group a knee has been formed between the coxale and the basale. In the families among *Podocopa* in which a knee is now formed between the protopodite and the endopodite, i. e. in Cyprids, Darwinulids, Nesideids and Cytherids, in other words in all the families of this group except *Cytherellidae*, the distal protopodite joint would be absent and so the knee would not be formed between the basale and the endopodite, but between the coxale and the endopodite. The joint-like process from which the second antenna in *Podocopa* issues would not originally have belonged to this limb. It seems, however, as is shown on p. 79 above, far from impossible that G. W. MÜLLER is quite mistaken in this matter. As a matter of fact it seems not at all improbable that the large distal protopodite joint in Cyprids, Darwinulids, Nesideids and Cytherids corresponds to the basale, and that a knee has thus been developed in these forms at the same place as in the families belonging to *Myodocopa*; in this way the formation of a knee between the coxale and the basale would only have arisen in the Cytherellids. The part of the second antenna that seems specially to support the affinity of the Cypridinids, Halocyprids and Polycopids is the exopodite. The agreement in structure is, as has been shown, too great to justify the assumption of convergence. It is, however, to be noted that G. W. MÜLLER himself assumed that this antenna had in the Protostracods an exopodite of the same type as in the Polycopids. Although this assumption is by no means proved yet, it is nevertheless, as has been pointed out above, not impossible that it is correct; on the contrary there seems to be a certain amount of probability that it is so, cf. p. 82. If this is correct it is obvious that this character will lose a great deal of its classificatory value. The endopodite of this family cannot be used as a basis for a classification of the sort assumed by G. W. MÜLLER. The fact that this branch is developed as a clasping organ in Cypridinids and Halocyprids seems to be of little importance. This is probably, as is shown on p. 82 above, a convergence phenomenon; at any rate it is not impossible that this is the case.

Mandible. Mandible: — According to G. W. MÜLLER's statement, 1894, *Myodocopa* is distinguished from *Podocopa* especially by its extensive and often very movable mandibular palp. This character is certainly of very slight classificatory value. As a matter of fact this limb is subjected to not inconsiderable variations both in *Myodocopa* and *Podocopa*. The mandible of the Halocyprids really approaches more closely to the type that is characteristic

for *Podocopa* than to that of Cypridinids and Polycopids. — In his work of 1912 G. W. MÜLLER does not mention this limb in the diagnosis of *Myodocopa*, a fact that seems to indicate that he has arrived at the same opinion about the classificatory value of this organ as that adopted in the present treatise.

Maxilla. Maxilla: — With regard to this limb it may be said that it shows less difference in *Myodocopa* and *Podocopa* than one would be inclined to believe from G. W. MÜLLER's statements. In *Polycopidae*, especially in a number of forms belonging to this family, we find a maxilla of so simple a type that from it we can quite naturally derive the types found in other families. In most of the forms belonging both to *Myodocopa* and *Podocopa* the protopodite is armed with three endites, in most cases powerful (in the Halocyprids two of these are, however, almost completely joined). In almost all recent Ostracods the endopodite of this limb has two or three joints: the number of joints varies, however, somewhat, both in *Myodocopa* and *Podocopa*. The most important difference according to G. W. MÜLLER would undoubtedly be that in *Podocopa* the exopodite is developed as a vibratory plate, while in *Myodocopa* this limb has no such organ. In this matter G. W. MÜLLER is, however, probably quite mistaken; see p. 34 above.

Fifth limb. Fifth limb: — As has been shown on p. 85 above, this appendage appears in very different types in the recent Ostracods. The type found in the Halocyprids differs very much from both the Cypridinids and the Polycopids, and has a striking resemblance, on the other hand, to the fundamental type in *Podocopa*. We must note, however, that, according to G. W. MÜLLER, the Halocyprids are to be regarded as primitive with regard to this limb, an assumption which, although not at all proved, cannot, as we have seen above, by any means be considered impossible. The *Myodocopa* would be characterized by a powerful vibratory plate on this limb. This character is, however, of slight significance. In the first place the vibratory plate is of rather moderate size in the Halocyprids; secondly we also find a rather powerful vibratory plate on this limb in forms belonging to *Podocopa*, e. g. a few Cyprids, all Nesideids and Cytherellids.

Sixth limb. Sixth limb: — This limb is absent in *Polycopidae* and apparently also in the females of the genus *Cytherella*. In Halocyprids and Cypridinids it appears in very different types; the type found in the former group shows a far-reaching agreement with the fundamental type in *Podocopa*. In the males of the Cytherellids we find a type that differs very much from both Halocyprids, Cypridinids and other Ostracods. G. W. MÜLLER considers this limb of the Halocyprids to be of a primitive type.

Seventh limb. Seventh limb: — This appendage is absent in both *Polycopidae* and *Cytherellidae*. In other forms it varies fairly considerably, but it may also be said of this limb — though with a certain amount of reserve — that in the Halocyprids it shows a greater agreement with *Podocopa* than with the Cypridinids.

Brush-shaped organ. Brush-shaped organ: — This organ is found both in *Myodocopa* and *Podocopa*. It is presumably of a comparatively slight classificatory value as it probably existed, as G. W. MÜLLER has pointed out, even in the Protostracods.

It is true that the furca in *Myodocopa* is of a relatively uniform type, but, as is shown on p. 95 above, it is by no means impossible that we are dealing here with a phenomenon of convergence. In *Podocopa* this organ is subject to very considerable variations. *Furca.*

The sexual organs vary very considerably in both *Myodocopa* and *Podocopa* and it is certain that they cannot be adduced as evidence either for or against the classification made by G. W. MÜLLER. These organs seem to be rather primitive in *Myodocopa*. *Sexual organs.*

Nor can the alimentary organs be used in support of G. W. MÜLLER's view. The type found in *Myodocopa* seems in all probability to be comparatively primitive. These organs are not known in the *Cytherella*. *Alimentary organs.*

A heart is found in Cypridinids and Halocyprids, but is absent in Polycopids and *Podocopa*. It existed in the Protostracods. *Heart.*

Lateral eyes are only found in Cypridinids. They were certainly to be found in the Protostracods. A median eye is found in Cypridinids and most *Podocopa*. It existed in the Protostracods. *Eyes.*

The rod-shaped organ is found in Cypridinids and Halocyprids, but is absent in the others. In the two former groups we are presumably concerned with a phenomenon of convergence; see p. 96 above. *Rod-shaped organ.*

Are there any other organs that might be used to support this classification of G. W. MÜLLER's? This question must, I think, be answered in the negative. *Other organs.*

It will be seen from this that G. W. MÜLLER's statement that the recent Ostracods can be divided into two sharply differentiated natural main groups can scarcely be considered as justified. The characters on which he based his assumption are partly such as he himself considered primitive and partly such as we have reason to believe have arisen by convergence.

In my opinion the Cypridinids, Halocyprids, Polycopids and Cytherellids form four well differentiated groups. The Cyprids, Darwinulids, Nesideids and Cytherids are, on the other hand, comparatively closely related to each other; they might conveniently be included in a higher classificatory unit, by the side of the four groups mentioned above. Thus, in my opinion, the Ostracods ought to be divided into five main groups*.

This view coincides on the whole with that of G. O. SARS; it really differs from this author's view only by the division of the *Myodocopa* into two groups, equivalent to the three other groups, the Cypridinids and Halocyprids having been separated. It agrees with C. CLAUS's view inasmuch as the Halocyprids are not grouped with the Cypridinids in a higher classificatory unit but differs from it because these two groups are taken as sub-orders and because each of them is considered to be parallel to the group composed of the united families *Cypridae*, *Darwinulidae*, *Nesideidae* and *Cytheridae*.

The question as to whether these five groups are to be considered as being of quite the same classificatory value cannot be answered at present with certainty.

* With regard to the characterization of these groups I need only refer here to the [illegible]

[illegible]

I did not think it convenient to use the nomenclature introduced by G. O. SARS for these groups. It seems unsuitable for the following reasons. The names *Myodocopa* and *Podocopa* have been used by preceding writers in different senses; if the name *Myodocopa* is retained for the Cypridinids or for the Halocyprids, it would be used in a new sense, differing from both G. O. SARS' and G. W. MÜLLER's view. If we retain the names *Myodocopa*, *Cladocopa*, *Podocopa* and *Platycopa* it would be impossible to introduce a thoroughly consistent nomenclature. G. O. SARS took these names from the structure of the second antenna in the different groups: *Myodocopa* refers to the muscular structure of this limb, μυώδης et κώπη, „the muscular oar"*. *Cladocopa* refers to the fact that both the exopodite and the endopodite are developed as natatory implements, κλάδος et κώπη „the branched oar". *Podocopa* refers to the fact that this limb is developed as a crawling leg, ποδός et κώπη „the leg-shaped oar". *Platycopa* refers to the flatness of the same appendage, πλατύς et κώπη, „the flattened oar". It seems impossible to find a suitable analogous name for Cypridinids and Halocyprids, as these groups have second antennae of almost quite the same type. It is also to be noted that the term *Cladocopa* suits one genus among the Halocyprids as well, namely *Thaumatocypris*.

For these reasons it seems to me most convenient to give quite new names to these five groups, which, according to G. W. MÜLLER, may be termed sub-orders. I have chosen for them the terms: *Cypridiniformes*, *Halocypriformes*, *Polycopiformes*, *Cypriformes* and *Cytherelliformes*.

[illegible] of the recent Ostra- [illegible] G. O. Sars and G. W. Müller.

The difference between G. O. SARS', G. W. MÜLLER's and my classification is shown in the following table:

Myodocopa G. W. MÜLLER		*Halocypriformes*
	Myodocopa G. O. SARS	*Cypridiniformes*
	Cladocopa	*Polycopiformes*
Podocopa	*Podocopa*	*Cypriformes*
	Platycopa	*Cytherelliformes.*

The question of the mutual relations between these groups seems to be exceedingly difficult to answer satisfactorily.

[illegible] groups. Cypridiniformes. Halocypriformes and [illegible]

G. W. MÜLLER assumes that Halocypriformes and Polycopiformes are more closely related to each other than they are to Cypridiniformes; Polycopiformes are to be considered as a small branch of the first-mentioned group, a branch that has preserved primitive features in a number of respects. The characters that show the closer relationship of these two groups would be the position of the first antenna high up on the forehead and the unsymmetrical exit of the sexual organs. I think that G. W. MÜLLER has been somewhat too hasty in this deduction. These two characters, the place of attachment of the first antenna and the way in which the sexual organs open out,

* G. O. SARS writes, 1865, p. 10: „Den sidste Del af Sammensaetningen, κώπη, Aare, er specielt anvendt paa disse Antenner, da deres Betydning som Bevaegelseorganer er noget, man vil finde mere eller mindre tydeligt udpraeget gaa igjennem den hele store Krebsdyrafdeling, *Entomostraca*. (The last part of the compound, κώπη, oar, is specially used for these antennae, as their importance as locomotory organs will be found more or less marked throughout the whole great Crustacean group *Entomostraca*.)

should not be given too much importance. With regard to the value of the former character the following facts may be instructive. In *Thaumatocypris* the first antenna is situated somewhat deeper down than in other *Halocypriformes.* In *Cypriformes* we find forms with both high and low places of attachment; this antenna of the Cyprids is fixed „hoch oben an der Stirn" (G. W. MÜLLER), while in the Cytherids and Nesideids it shows a resemblance to that of the Cypridinids „besonders in der tiefen Einlenkung an der Stirn" (G. W. MÜLLER, 1894, p. 29). With regard to the way in which the sexual organs open, we may, in the first place, mention the important differences that are actually to be observed between Polycopids and Halocyprids, and, secondly, that the Cytherellids are also characterized by an unsymmetrical exit of these organs (Note too the resemblance — superficial, it is true — that exists between the copulation organ in Cytherellids and Halocyprids). I do not think G. W. MÜLLER would bring forward this character as a sign of close relationship between Cytherellids and Halocyprids. In my opinion it is not at all impossible that we have here a phenomenon of convergence.

Halocypriformes, *Cypridiniformes* and *Polycopiformes* are probably to be regarded as three groups fairly independent of each other. That nevertheless they resemble each other not inconsiderably in a number of characters is due, first, to the fact that in several respects they show primitive featurs, and, secondly, to convergence.

It seems difficult to decide which of these three groups is to be taken as the most primitive. The facts of the matter are probably that each group is in a number of respects more primitive than the two others, while in other respects, on the contrary, it is more developed. Thus, for instance, *Cypridiniformes* are presumably primitive inasmuch as, let us say, the lateral eyes, median eye, the heart and the two posterior limbs are developed, but they differ from the original type in having a rostral incisur and a rod-shaped organ, and in the structure of the second antenna and the maxilla. *Polycopiformes*, which have no lateral eyes, median eye, heart or two posterior limbs are, on the other hand, presumably primitive with regard to the rostral incisur, the rod-shaped organ and the structure of the second antenna and maxilla.

It is at least equally difficult, perhaps even more so, to determine with certainty the *Cytherelliformes*
natural position of the *Cytherelliformes* in the Ostracod system.

G. W. MÜLLER placed this group together with the families *Cypridae*, *Darwinulidae*, *Nesideidae* and *Cytheridae.* The same author points out in his work of 1894, p. 190, that the Cytherellids show „wenige, aber immerhin beachtenswerthe Beziehungen zu den Cypriden". The characters by which this group would show agreement with *Cypriformes* are the following: Second antenna: The group of sensory bristles on the first joint of the endopodite and the group of five bristles distally on the inside of the same joint. The use of the fifth limb as a clasping organ in the males.

What value can we assign to these characters from a classificatory point of view?

Second antenna: With regard to the second antenna it ought to be pointed out that similar sensory bristles are also found in the Cytherellids proximo-posteriorly on

the second and third endopodite joint of this limb. I do not understand at all what G. W. MÜLLER means about the other character. In the first place the number five is not at all universal for these bristles in the C y p r i d s; cf., for instance, figs. 1, 2 and 13 of pl. 13 in G. W. MÜLLER's work of 1894. The first two figures show the second antennae of *Paracypris rara* (G. W. MÜLLER), ♂ and ♀; the former is characterized by seven, the latter by six bristles at this place. Fig. 13 of *Macrocypris succinea* G. W. MÜLLER, shows four bristles at the corresponding place. If we examine more closely G. W. MÜLLER's figure of the second antenna of *Cytherella sordida* G. W. MÜLLER, 1894, pl. 32, fig. 3, we shall find that the first endopodite joint has a dense row of powerful bristles along the whole of the inside of the distal boundary; I think as many as eleven can be counted. The same was true of a species of this genus that I had an opportunity of investigating; there I counted twelve bristles. A row of similar bristles is also found, in addition, distally on the inside of the first exopodite joint of this antenna in the C y t h e r e l l i d s. From a structural point of view too the distal bristles on the first endopodite joint in *Cytherella* show no resemblance to those similarly situated in the family *Cypridae*.

F i f t h l i m b: — With regard to the strength of the evidence afforded by the last-mentioned character of G. W. MÜLLER's it will perhaps be sufficient to point out, first, the great difference that exists between the male fifth limb in C y t h e r e l l i d s and C y p r i d s, secondly, that in the families most closely related to the C y p r i d s, namely the N e s i d e i d s and the C y t h e r i d s, this appendage is not modified in the males as a clasping organ, but is developed as a typical crawling leg and, thirdly, that in the males of *Cytherella* the sixth limb too is developed as a clasping organ, perhaps resembling in its type the fifth limb of the C y p r i d s even more than the fifth limb does.

This seems to show that we have every reason to consider that the classificatory evidence afforded by the characters brought forward by G. W. MÜLLER is rather uncertain.

On the same page of the work quoted above G. W. MÜLLER states that there is possibly a close relationship between C y t h e r e l l i d s and D a r w i n u l i d s „in der Vermehrung der Borsten des 1. Tastergliedes der Mandibel und ihrer Anordnung zu einem Kamm". A similar comb of bristles also occurs on the maxilla of *Cytherella*, but not, on the other hand, on this limb in D a r w i n u l i d s. Might not this be explained as a sign of relationship with *Asterope*?! I think that we shall not arrive very far with such uncertain assumptions. It is obvious that G. W. MÜLLER himself does not attach much value to his surmise. He writes (p. 190) as follows: „Legt man Werth auf diese Beziehung, so wird man zu der Annahme gedrängt, daß die D a r w i n u l i d e n die Vorläufer der C y t h e r e l l i d e n waren, ihnen nahe stehen; dies halte ich aber wegen der übrigen starken Abweichung für unwahrscheinlich."

I do not mean by this to say that *Cytherelliformes* are not more closely related to *Cypriformes* than they are to any other group. As a matter of fact I consider that this is by no means impossible. What I wish to say is that the position of this group, which is aberrant in almost all respects, is very uncertain and that so far no evidence has come to light that allows us to assign to it with any degree of certainty a place in the natural system of the O s t r o c o d s.

Cypriformes. With regard to the classificatory position of the four families belonging to *Cypriformes* G. W. MÜLLER assumes that the C y p r i d s are nearest to the original type; the N e s i d e i d s

would have issued from the Cyprids, the Cytherids from the Nesideids. The Darwinulids would be rather closely related to *Cypridae*. He obtained his arguments for this view from the three posterior limbs and the furca. With regard to the former he points out that the protopodite is closely joined to the body in Cyprids, is somewhat more free in *Nesideidae*, and is most free in *Cytheridae*. The distal joint of these limbs is distinct and is armed with three well-developed claws in the Cyprids; it is very small and is armed with only one long claw and two small bristles in *Nesideidae*; in the Cytherids it is quite joined to the end claw and traces of the two bristles can only sometimes be observed. The fifth limb is used in the Cyprids as a masticatory implement and consequently it is provided on its anterior side with a masticatory process armed with bristles, or else with a number of bristles; at the corresponding place the fifth limb in *Nesideidae* has a number of bristles; it is not used, however, as a masticatory organ; in the Cytherids the number of these bristles is still more reduced. The furca is well developed in the Cyprids; in the Nesideids it is somewhat smaller; in the Cytherids it is always very small. G. W. MÜLLER then writes, p. 190: „Ich brauche kaum zu sagen, daß ich die Bairdien" (= *Nesideidae*) „in ihrer heutigen Form nicht für eine getreue Copie der Stammform der Cytheriden halte, ebensowenig wie ich in den heutigen Cypriden die Stammform der Bairdien oder der gesammten *Podocopa* sehe, sondern glaube nur, daß unter den heute lebenden Arten die genannten jenen hypothetischen am nächsten stehen, daß also die Aehnlichkeit der heutigen Bairdien mit jener Form besonders groß ist."

G. ALM, in his work of 1915, pp. 17—18, subjects these arguments put forward by G. W. MÜLLER to a critical examination, which seems to me fully justified. He argues as follows: It is certainly true that the protopodites on the three posterior limbs in the Cytherids are more free than in the *Nesideidae*, but in the Cyprids one can detect a tendency in the opposite direction. „Hier ist nämlich der Stamm ungefähr gleich bei den niederen wie bei den höheren Formen und sollte die Beweglichkeit verschieden sein, so wären es die niederen Formen, die Unterfamilien *Pontocyprinae* und *Macrocyprinae*, wo man die größere Beweglichkeit finden sollte. Noch mehr ist dies der Fall bei der den Cypriden nahestehenden, aber vielleicht nicht so weit wie diese vorgeschrittenen Familie *Darwinulidae*, wo der Stamm beinahe so frei ist wie bei den Nesideiden." With regard to the second reason that G. W. MÜLLER adduces, namely the reduction of the number of bristles on the end joint of these limbs, G. ALM writes: „Das letztere Verhältnis ist ähnlich innerhalb der beiden Typen" (on the one hand *Cypridae*, on the other *Nesideidae-Cytheridae*) „und zeigt also nur, daß es eine Tendenz zum Verschwinden der Börstchen bei den *Podocopa* gibt." This author writes as follows about the fifth limb: „Während dieses Beinpaar bei den niederen Cypriden sowohl als Freßorgan wie als Bein fungiert, hat es bei den höheren Cypriden nur die erstere Aufgabe. Bei den Nesideiden und Cytheriden wieder ist es vollständig als Bein ausgebildet, hat aber bei den Nesideiden mehrere Borsten an der vorderen Seite, obgleich das Beinpaar wahrscheinlich nicht mehr zur Nahrungsaufnahme dient. Hier haben wir also wieder entgegengesetzte Tendenzen, etc." According to G. ALM the furca must be considered as of little value as classificatory evidence, as this organ is often developed very

differently in very closely-related forms. — I may state here in passing that I have found a hitherto undescribed genus*, quite without any furca; this genus is certainly closely related to *Macrocypris*, a Cyprid genus which is considered, probably quite correctly, to be a primitive one. This facts of course supports G. ALM's view. — Other reasons too, obtained from the seventh limb and the sexual organs, have been adduced by G. ALM against G. W. MÜLLER's view (cf. G. ALM, 1915, pp. 18—21).

In G. ALM's opinion the four families belonging to *Cypriformes* have „beinahe gleichzeitig" entered on two separate lines of development; *Darwinulidae* and *Cypridae* have developed in one direction, *Nesideidae* and *Cytheridae* in the other. He thus denies „daß der eine oder der andere Typus von dem zweiten abstammt" (p. 17). He considers that it is difficult to decide the question as to whether the Nesideids or the Cyprids are more closely related to the original forms, but he adds, curiously enough, that this is „bei meiner Auffassung nicht von größerer Bedeutung".

This author sums up his view in the following words. „Das verschiedene Aussehen von MÜLLER's und meinem Stammbaum liegt also darin, daß nach ihm die *Nesideidae-Cytheridae* ziemlich hoch oben am Cypriden-Stamm ihre Abstammung hat, während nach meiner Auffassung diese beiden Gruppen, einerseits *Cypridae* mit der kleinen Familie *Darwinulidae*, andererseits *Nesideidae-Cytheridae*, ziemlich bald nach der Abgrenzung von *Myodocopa*, sich voneinander getrennt und nachher vollkommen selbständig entwickelt haben." These forms would consequently have branched off fairly soon after the *Cytherelliformes*. The genealogical tree of the Ostracods has thus, according to this writer, the type shown in my fig. VIII. This may, of course, appear to be rather similar to the genealogical tree drawn up by G. W. MÜLLER 1894, p. 191; the difference is, however, perhaps better shown by a comparison between this diagram and that of G. W. MÜLLER's as re-constituted by me in the present work, fig. IX.

C. CLAUS, in his work of 1876, p. 98, puts forward another view. According to him the Cyprids have developed from the Cytherids. A. KAUFMANN took the same view in his work of 1900, p. 244, „wenn wir die marinen Cytheriden . . . als direkte Stammformen der Cypriden ansehen". Neither of these two authors has tried to give any detailed reasons for their views.

According to C. CLAUS (loc. cit.) the Cytherids have developed from the Halocyprids „oder vielleicht besser von einer nahestehenden, bislang nicht näher bekannt gewordenen ausgestorbenen Ostracodengruppe". According to this writer the pedigree of the recent Ostracods is thus of the following type: (fig. X). (This writer does not say anything about the position of the Polycopids, Nesideids and the Cytherellids.)

Summary of the results of my studies on the mutual relations of my five main groups.

It seems exceedingly difficult to decide how far the „pedigrees" of these three authors are to be considered correct. It seems to me not impossible that G. ALM's view as to the classificatory position of the four families belonging to *Cypriformes* is nearer to the truth than G. W. MÜLLER's. On the other hand it

* This form will be described in a following part of this work.

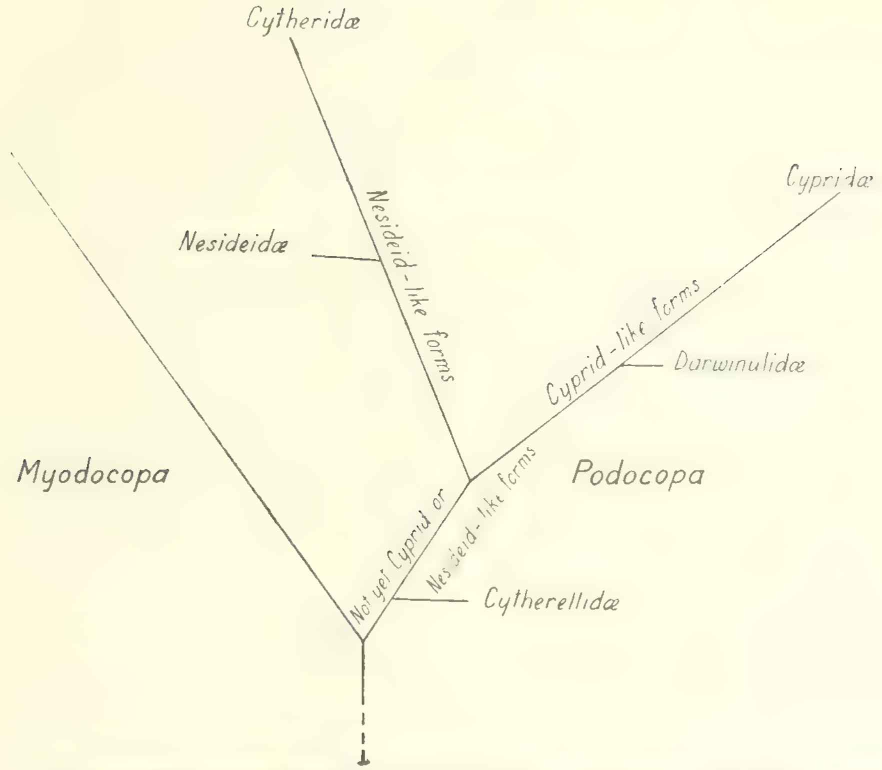

Fig. VIII. — The pedigree of the recent Ostracods, according to G. Alm's exposition 1915.

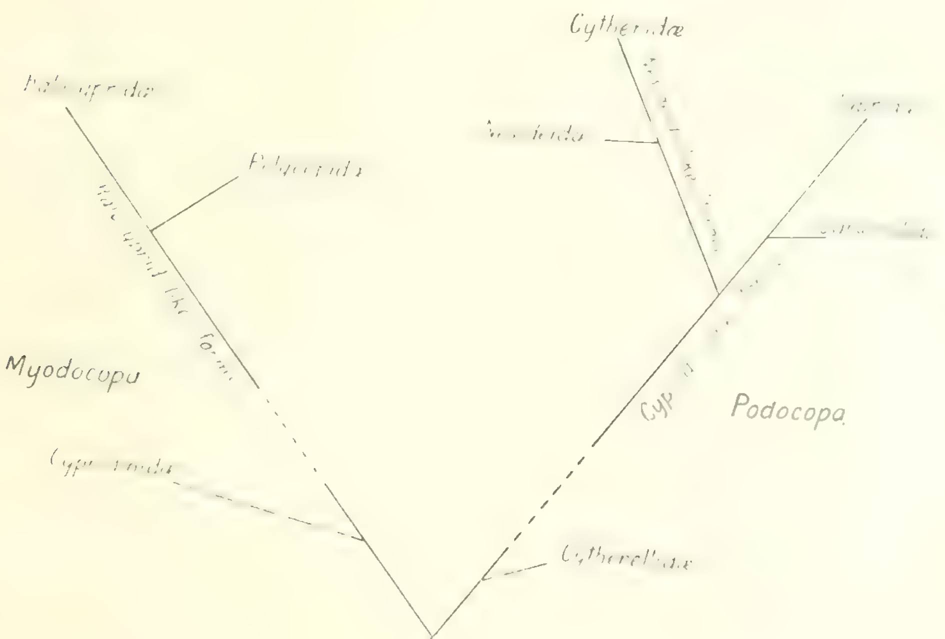

Fig. IX. — The pedigree of the recent Ostracods, according to G. W. Müller, 1894 (somewhat modified).

seems anything but probable that C. CLAUS' view that the Cyprids have developed from marine Cytherids is correct. But it is quite impossible to solve this problem definitely in the present state of affairs.

It seems to me by no means impossible that *Cypriformes* have branched off from the ancestors of the Halocyprids after the latter had been differentiated from Cypridinids and Polycopids. This question will only be able to be solved after the solution of the problem as to whether the foliaceous type of the fifth and sixth limbs of Cypridinids is a primary or a secondary one. A number of features in the anatomy of the Polycopids seem to indicate that this group branched off from the other groups at a very early stage, presumably before the Cypridinids, and consequently long before the time indicated in the pedigree drawn up by G. W. MÜLLER. On the other hand it seems to me quite impossible at present to decide when the original forms of the Cytherellids were differentiated from other Ostracods.

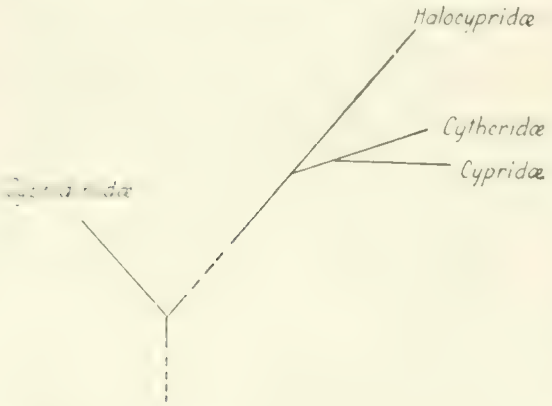

Fig. X. — The pedigree of the recent Ostracods according to C. CLAUS' statements.

[illegible] chapter.

It will be seen that the result of this enquiry has been to a great extent negative. Only in a comparatively few respects has it seemed to me possible to follow more or less without reservations the views of previous writers as to the organization of the Protostracods and the natural grouping of the recent Ostracods; in most cases I have been compelled to doubt or even to reject the suggestions made by them. I did not think I could construct any „genealogical tree", nor did it seem possible to accept any of those previously drawn up. I have only been able to bring a small number of new facts into the discussion. This is due especially to the fact that only a few phylogenetically important forms have been included in the literature of late. Only one such form has, as far as I know, been added: I refer to the curious genus *Thaumatocypris*. But I hope that this investigation will not prove to be of no importance.

CHAPTER III.

Contributions to our knowledge of the Ostracods' adaptation to a planktonic life.

Introductory remarks.

It was at first my intention to put forward even in this part of my work all the results at which I had arrived during my studies of the Ostracods' adaptation to a planktonic life. But because of the great space demanded by the other chapters of this work and the difficulties in printing that are now prevalent, it seemed to me best to postpone for the present the publication of a portion of these results. Here I shall only try to show briefly the relation of the Ostracod group to the theory put forward by R. WOLTERECK, 1913, of the function of the „sogen. Schwebe-Fortsätze pelagischer Cladoceren", as the results attained by me with regard to this question seem to be of such general interest that a rapid publication of them seems desirable.

An account of R. Woltereck's view.

First I shall give an account of R. WOLTERECK's view:

The original method of preventing sinking in the Cladocera.

A number of forms in the *Cladocera* are at present, as it were, at a transitional stage between littoral life and planktonic life. This transition can perhaps be best studied in the genus *Chydorus*, for instance in *Ch. sphaericus*. This species still lives to some extent the life that is presumably the original one for the *Cladocera*, namely a crawling and jumping life at the bottom or on the water vegetation in the littoral region. Sometimes, however, it swims, and then it occasionally penetrates into the pelagian region of the lakes. „*Chydorus sphaericus* bewerkstelligt die Eroberung der pelagischen Region dadurch, daß er seinen schweren Körper mittels kräftiger Ruderschläge durch das Wasser trägt." This form is, however, not entirely independent of the substratum even during its pelagian excursions; now and then it has to rest on foreign floating objects, e. g., clusters of algae, etc.

The method by which this form prevents itself from sinking down during its pelagian excursions, i. e. self-motion, swimming, is, according to R. WOLTERECK, certainly the original one for the group *Cladocera*.

This method of preventing sinking represents, however, a serious consumption of energy. — A closer study of the plankton world of our seas and lakes shows how the organisms

try in many ways to decrease this consumption of energy by increasing their power of passive buoyancy.

According to W. OSTWALD's works (1902, 1903a and b)

$$\text{„Sinkgeschwindigkeit} = \frac{\text{Übergewicht}}{\text{Formwiderstand} \times \text{Viskosität des Wassers“}}.$$

Of these three factors the overweight and the form-resistance have been denoted as the biological ones, because they are dependant on the organism. An increase in the power of buoyancy is thus produced (if the viscosity = the inner friction in the water is constant) by the overweight being decreased and the form resistance increased.

According to A. STEUER, 1910, p. 190, a decrease of the organism's overweight in the plankton world has been produced in the following ways:

1) by the secretion of mucus and the development of jelly substance, by the development of strongly aqueous tissues,

2) by the formation of vacuoles,

3) by the accumulation of specifically light metabolic products, e. g. gas, fat and oil.

An increase of the friction resistance in these organisms has been produced, according to the same writer (loc. cit.):

1) by an increase of the whole (relative) surface of the organism („Trommeltypus“ according to SCHRÖTER),

2) by the organism obtaining a lamellar form („Discoplankton“ according to OSTENFELD),

3) by the extension of the body in one direction (rod-shape),

4) by the development of „regelrechter Schwebeapparate“, e. g. the long processes in *Chaetoceras*, a multitude of spines and bristles in *Crustacea*, etc.,

5) by the formation of colonies („Froschlaichtypus“).

What is strived after in these five cases is obviously an increase of the horizontal cross-section.

What is the relation of the planktonic *Cladocera* to these two factors?

A tendency to decrease the overweight can be observed in all of them. This decrease has in most cases been brought about by the chitin and the tissues of the body becoming finer and by the development of fat. In exceptional cases *(Holopedium)* it has been produced by the development of a covering of jelly. In a number of species, e. g. *Diaphanosoma*, the decrease of specific gravity has proceeded so far that the latter has almost coincided with that of the water; these forms can „in scheinbar beliebiger Lage im Wasser ‚stehen' bleiben“. In most of the planktonic *Cladocera*, however, the specific gravity has been decreased rather inconsiderably.

By what means are the latter forms kept buoyant?

According to R. WOLTERECK (and C. WESENBERG-LUND, 1908), in these forms, as in the genus *Chydorus*, the principal factor in preventing sinking is self-motion (swimming).

The first-mentioned writer has in the case of these forms accordingly written the above-quoted buoyancy formula established by W. OSTWALD, in the following way:

$$\text{,,Sinkgeschwindigkeit} = \frac{\text{Übergewicht} \times \text{Abwärtsbewegung und -steuerung}}{\text{Reibung} \times \text{Aufwärtsbewegung und -steuerung``}}.$$

The factor ,,Reibung" in this formula, which includes both the viscosity of the water and the friction between the sinking body and the water, i. e. the form-resistance, appears, according to this author, in these forms (as in the actively swimming forms of *Crustacea* in general) not to have ,,eine besonders große Bedeutung", p. 480.

The shape of the body in the pelagian *Cladocera* varies, however, to a very great extent; many of them are characterized, for instance, by more or less excessively developed processes of different kinds.

How are the more or less extensive processes on the shell of the Cladocera to be explained?

How are these processes to be explained?

1) Buoyancy organs.

The most widely spread view seems to be that these processes are to be explained as buoyancy organs.

2) Balance organs.

A view that differs somewhat from this is put forward by C. WESENBERG-LUND; in a work of 1908 this eminent author writes as follows (p. 12): ,,I am inclined to believe on the whole, that many of these buoyancy-organs which have hitherto been considered of importance only in as far as they increase the cross-section resistance and surface-area, play a by no means small role in shifting the centre of gravity of the body", i. e. a number of these processes function as balance-organs as well as buoyancy organs. In support of this view observations made on the genus *Bythotrephes* are given in the work mentioned; thus we read (p. 12): ,,As mentioned above I have never seen *Bythotrephes* floating; it hops about always in the aquaria with innumerable, small and short jumping movements; it gives one the impression of being an excellent swimmer but not a floating organism. I have never seen it use its long, posterior legs as outriggers; it drags the long spine behind it during swimming and we might think on a cursory glance that this was rather a hindrance. The direction of movement is as a rule distinctly horizontal. If we now remove the spine, which can easily be done with a good pair of scissors, we change the *Bythotrephes* to a dancing figure, waltzing round and round in spirals or closed circles; they finally end at the bottom, from which they never again rise. The spine has thus actually been a balancing organ, which has played the role of moving the centre of gravity, so that a horizontal movement could be possible; further it is a buoyancy organ, which according to its point of insertion and the position it gives the body in the water augments the cross-section resistance."

The same view (which was afterwards adopted by F. E. RÜHE, 1912, among other writers) had already been previously (1896) expressed by C. CHUN with regard to a number of other pelagian *Crustacea*. After an expression of this opinion we read in the work mentioned (p. 103): ,,Sind die betreffenden Formen mit kräftigen Ruderfüßen versehen, so liegen die Balancirstangen horizontal in der Mediane und bedingen bei dem Durchschneiden des Wassers eine geradlinige Fortbewegung und einen geringen Widerstand."

R. WOLTERECK contests both these views in his work quoted above. The reasons that seem, in the opinion of this writer, to controvert the explanation of these processes as buoyancy organs are as follows (pp. 485 and 486):

1) A number of the extremely developed processes, e. g. the crest in *Hyalodaphnia*, the horns in *Bosmina*, are carried during swimming more or less vertically, i. e. they do not contribute or contribute only very slightly by their position to increase the horizontal cross-section of the organism.

2) Such processes in animals with variable energy of motion and variable specific gravity can scarcely be explained as arrangements merely for increasing the power of buoyancy unless they are extensive, because otherwise their importance compared with the two former factors is too slight to be decisive.

3) The main argument in favour of the buoyancy function, namely the temporal variation in *Hyalodaphnia*, is not absolute evidence for this explanation. It is true that the crest becomes longer in summer, but this does not prove the function postulated, as the head often becomes considerably shorter in the late summer water, which is often very warm. This corresponds to the experiments carried out by WOLTERECK; in warm water a low crest can be obtained and a high crest in cold water according to the intensity of the assimilation.

4) *Bosmina longirostris* and *B. (coregoni) longispina* are characterized in many places in summer by short and in winter by long processes, i. e. exactly the opposite of what one would expect according to the principle of buoyancy (the viscosity of the water decreases, as we know, with a rise in temperature). WOLTERECK carried these *Bosmina* from water with a temperature of about 12° C to water of 25° C and gave them abundant food; the anterior processes (first antennae) in these experimental animals were very considerably shortened, almost 50 %.

In order to test whether the explanation of these processes as balance organs was correct R. WOLTERECK carried out the following experiments:

1) The long crest in *Daphnia cucullata* was removed. The result of this was that the animals got on the average a more vertical position, such as is characteristic for the short-crested D a p h n i d s. A consequence of this was that the operated animals swam in more steeply ascending courses. „No disturbance of the equilibrium, which must show itself in an unnatural position and direction of movement, occurred after the loss of the crest. This consequently has not the function of rendering possible the retention of the typical Daphnid position, i. e. of making up for (‚ausbalancieren') an otherwise one-sided weight. On the contrary it has the function of altering the typical Daphnid position (for the originally crestless forms) in a definite way. Because of this we cannot explain it as a balance organ, although it influences the position of the centre of gravity." The removal of the spina in these animals had, on the other hand, no essential effect on the position of equilibrium; the motion of the operated animals became, however, less straight.

2) After the removal of the first antennae in *Bosmina longirostris* the motion of the experimental animals was altered from being in a straight line to a continuous backward rotation. „Die Störung beruht aber nicht in einer Verschiebung des Schwerpunkts: operierte wie unoperierte Tiere sinken, wenn man sie betäubt oder tötet, mit dem Rücken nach unten."

In other words these experiments certainly seemed to show that a number of processes in these animals influence more or less the position of the centre of gravity, but, as R. WOLTERECK points out, this influence was often so slight that it not „genügt zur Erklärung".

What are then the functions of these processes? According to R. WOLTERECK they ought to be looked upon as stability and steering organs, i. e. organs for bringing about swimming in a straight line. As a matter of fact a similar explanation had been put forward more in passing by G. BURCHHARDT, 1900, p. 282, in the case of the anterior antennae and the mucrones in *Bosmina* and the spina in *Daphnia*; when WOLTERECK worked out his treatise this statement of G. BURCHHARDT's was, however, unknown to him (see p. 525). *3) Organs for stability and steering.*

WOLTERECK supports his theory especially by a very thorough analysis of the swimming of the Daphnids and of the genus *Bosmina*. The result of this analysis is briefly as follows: *R. Woltereck's proofs of his view.*

1) In the Daphnids, which take up an almost vertical position when at rest, the second antennae, in which the animals are, so to speak, hung up, strike upwards and backwards during swimming. On account of this a continuous displacement of the longitudinal axis is produced during swimming. This displacement is illustrated by WOLTERECK by the adjoined figure XI. *The method of swimming of the Daphnids and Bosmina.*

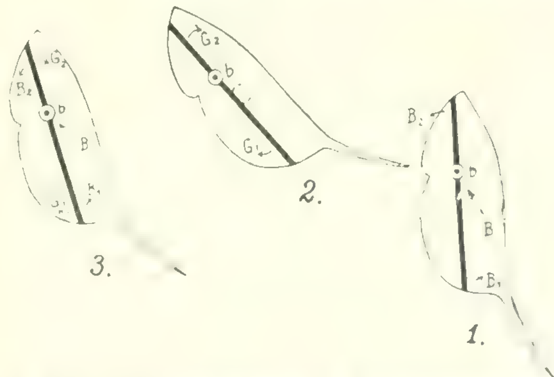

Fig. XI. The displacement of the longitudinal axis of the body of *Daphnia* during swimming (From R. WOLTERECK, 1913).

The following explanation is given of this figure: „Instead of the longitudinal axis of the body one may imagine a rod, which is first (phase 1) suspended at the point b and receives a blow against this point from the direction B. The result of this is, first, a progressive movement in the direction B and, secondly, a displacement of the forepart of the body in the direction B_2 and of the back part of the body in the direction B_1. Phase no. 2: We imagine that the progressive motion is finished and thus the body is now suspended (with its antennae extended) at point b in a position caused by the blow last mentioned. Now gravitation exerts a downward drag in the direction G_1 on the heavier back part of the body and an upward pull on the head in the direction G_2. (The dotted line denotes the position of the centre of gravity.) Phase no. 3: This shows the result of this effect of gravitation at the moment when a new thrust is made by the natatory antennae in the direction B. As the axis has not yet reached the position of equilibrium (the centre of gravity is under b), it is affected simultaneously by gravitation and the natatory thrust in directions opposite to each other."

In *Bosmina*, which in its normal position is suspended by the second antennae and has the ventral side downwards, the natatory strokes are directed downwards and backwards. In these forms too a continual displacement of the longitudinal axis consequently takes place during swimming. WOLTERECK illustrates this displacement with the following figure XII.

The following explanation is given of this figure: „Phase no. 1: Normal position in swimming. The natatory stroke influences the longitudinal axis suspended at point b forward in

the direction B. It also produces a displacement of the axis in the direction B_1 and B_2. At the same time the force of gravity produces an effect in the same direction, G_1 and G_2. Phase no. 2: The result of 1. Phase no. 3 (not realized): The result of the forces B and G during phase no. 2."

In other words both in Daphnids and Bosminids a displacement of the longitudinal axis of the body is produced by the strokes of the natatory antennae. In the former this displacement is opposed, in the latter assisted, by the force of gravity.

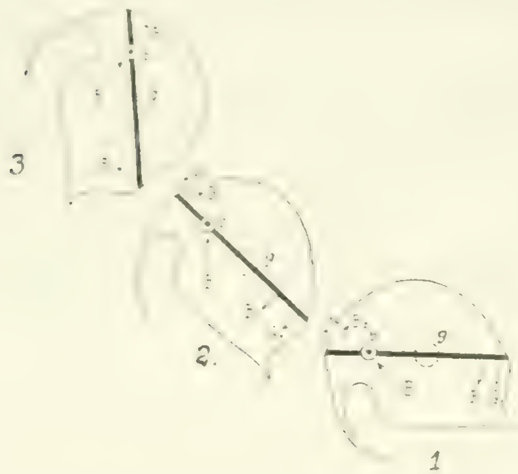

Fig. XII. — The displacement of the longitudinal axis of the body of *Bosmina* during swimming. (From R. WOLTERECK, 1913.)

In the genus *Bosmina*, provided there are no obstructing forces, an overturning backwards ought consequently to result. If, however, we watch a *Bosmina* swimming, we see, as R. WOLTERECK has pointed out, that it goes forward rather swiftly and in a straight line through the water, usually with its ventral side downwards. The factor that makes a straight-lined progressive movement possible and prevents overturning is, according to the same writer, the resistance of the water. WOLTERECK illustrates the resistance of the water with the following figure XIII.

The following explanation of figure XIII is given: ,,a) The influence of the resistance of the water (W) on the direction of the motion of a body that is driven forward by a force applied at a point b in the direction B. W_1 and W_2 = the deviation of the longitudinal axis due to the greater pressure against the upper half of the body. This results in a continual deviation of the direction of motion from B to F. b) This illustrates the same case as fig. a, but a steering surface (S) is developed, which makes the resistance of the water equally great against the upper half and the lower half of the body. Result: The retention of the direction of the force as direction of the motion. If the steering surface is somewhat longer or wider the body is made to move forward in the direction of its longitudinal axis (F_1)."

The co-operation of these three forces, the natatory strokes of the antennae, the force of gravity and of the resistance the water, in the swimming of the Daphnids and *Bosmina* is illustrated by WOLTERECK by the accompanying figures XIV and XV.

...ome other facts in ...pport of Wolter- ...k's opinion, ad- ...nced by this author.

This explanation is supported by the above-mentioned amputation experiments that WOLTERECK carried out on Daphnids and Bosminids. The fact that in many places *Bosmina longirostris* and *B. (coregoni) longispina* have short processes during summer and long ones

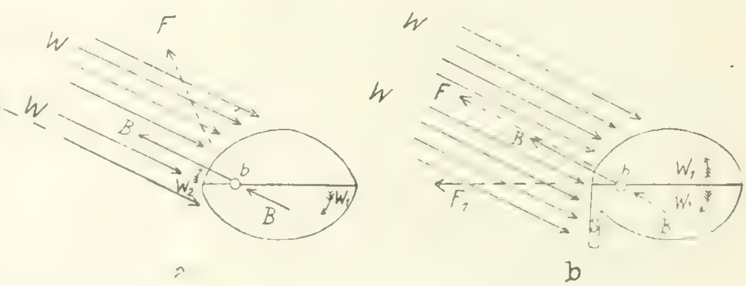

Fig. XIII. — Diagrams showing the influence of the resistance of the water. (From R. WOLTERECK, 1913.)

in winter is also explained in this way. „In summer these animals swim", as WOLTERECK points out, p. 505, „in warm water and when abundantly fed they have swift and energetic natatory strokes; in cold water and with less intensity of assimilation in winter they swim ‚at half speed' and consequently need longer steering surfaces."

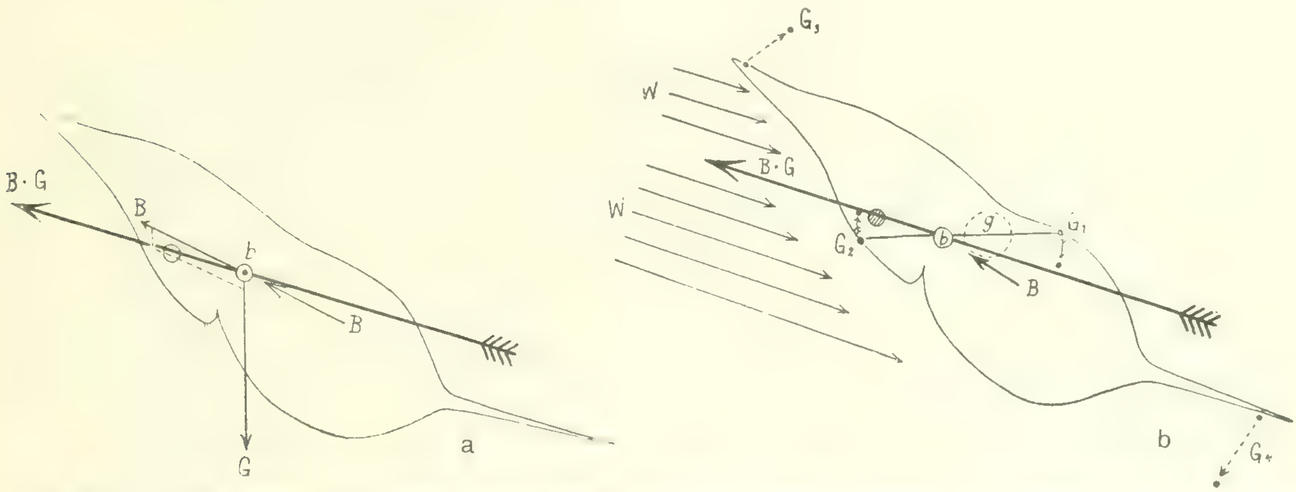

Fig. XIV. — The factors of the direction of motion in the high-crested *Hyalodaphnia* (Reproduction of fig. 28 in R. WOLTERECK's work of 1913).

a) „Effect of self-motion (direction B) and deviation due to gravitation (direction G). The resultant of the parallelogram of forces is the direction of motion B. G."

b) „The total effect of the propelling force, the twisting of the axis, the resistance of the water, the spina and the crest. The dotted arrows show the displacement of the points *G* 1—4, when the head is pressed up about as much as the width of an eye. In this cases the spina acts as a ventral rudder pressing down the head. When, on the other hand, the head is pressed just as much down in the natatory movement (fig. XI: 2), the spina is raised to the same extent and then has a lifting effect on the head (dorsal rudder); it is thus here, on account of its position in the direction of the motion, a typical stability surface. The body always acts as a ventral rudder because of the different resistances met by the water in the case of the head and the body. The number of the arrows drawn at equal distances from each other only shows the difference of pressure in one plane. As a matter of fact the broad body is subject to a much stronger pressure than the narrow head."

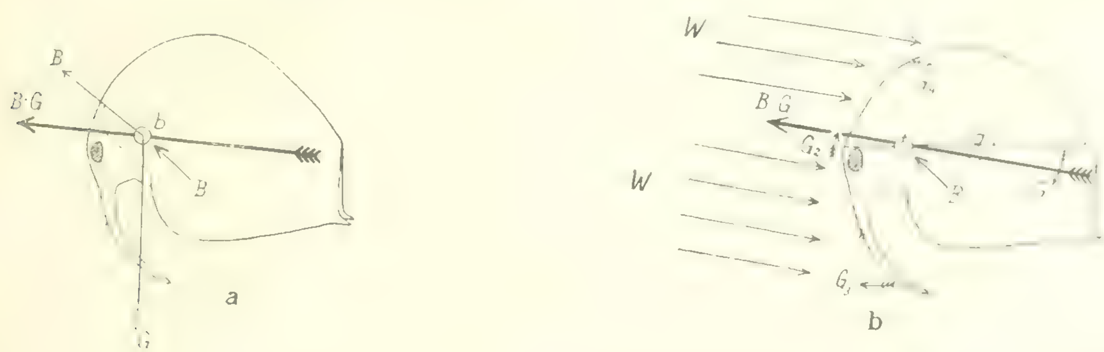

Fig. XV. — Factors in the direction of motion of *Bosmina* (Reproduction of fig. 18 in R. WOLTERECK's work of 1913).

a) „The effect of self-motion (direction B) and deviation owing to gravitation (direction G). The resultant of the parallelogram of forces is the direction of motion B. G."

b) „The axis-twisting effect of gravitation at four different points of the body, when the head has been pressed up about as much as the width of the eye = G. g = centre of gravity. W = the effect on the dorsal and ventral sides of the body of the water displaced in swimming forward."

This explanation given by R. WOLTERECK of the crest and spina in the D a p h n i d s and the anterior and posterior processes (the first antennae and the mucrones) in *Bosmina* as steering and stability organs is certainly very interesting, but is it correct?

Even for the reasons put forward by this writer it seems to me very probable that this question must be answered in the affirmative. We may grant that they do not posses these functions alone, but it seems certain that these are among the most important.

Seen from this point of view the experiment with *Bythotrephes* quoted on p. 111 above carried out by C. WESENBERG-LUND seems more comprehensible. It seems surprising that the removal of the fine spina should have so powerful an effect if it only influences the position of equilibrium. If, on the other hand, the function of this process as a steering and stability organ is taken into consideration, we have a different state of affairs.

Fresh light is also thrown upon the statement of C. CHUN quoted on p. 111 above with regard to the connection between the force of the natatory movements and the direction of the processes. No causal connection seems to exist between these two factors; on the other hand the direction of the processes is presumably dependant on the direction of the natatory movements.

How does the Ostracod group stand in relation to this problem?

In answer to this question I must say that all the facts that I have ascertained during my investigation of this group decidedly support R. WOLTERECK's view as given above.

In all the planktonic forms of this group, as in the *Cladocera*, a decrease of the overweight can be established. This decrease is often brought about by a reduction of the amount of lime in the shell, by the chitin and a large number of tissues becoming finer and by the development of fat. We find a good example of the reduction of the lime in the genus *Philomedes*; while during life at the bottom the species of this genus are characterized by heavy and very calciferous shells, during the pelagian period, i. e. the time just after the moult at which maturity is reached, they have shells comparatively poor in lime. A number of pelagian forms, e. g. *Gigantocypris*, *Thaumatocypris*, even seem to be quite without lime. With regard to the development of fat (oils) C. CHUN* wrote as early as 1896, p. 101: „Weit verbreitet ist hingegen das Auftreten von Oeltropfen, welche durch ihr geringes specifisches Gewicht das Schweben ermöglichen. Die C l a d o c e r e n, O s t r a k o d e n etc. sind oft so überreich und so constant mit Oeltropfen ausgestattet, daß gerade den mit relativ glatten Oberflächen versehenen Organismen das Schweben ermöglicht wird.“ — In a few cases (the species of the genus *Gigantocypris*) the decrease of the specific gravity has gone so far that we may speak of passive buoyancy. In this genus — which lives both at very great depths (2700—3600 metres) and near the surface of the ocean (about 200—150 metres in the Sargasso sea, consequently in water of comparatively slight viscosity) — the specific gravity seems practically to correspond to that of the surrounding medium; the tissues are fine and exceedingly aqueous; when one dissects the animal from the shell there is an exceedingly

* The same writer also states (loc. cit.) that „Ausbildung von Gallertsubstanz durch Aufnahme von Wasser“ — as in, for instance, the H y p e r i d s — is also indicated in some H a l o c y p r i d s. As I have not found any other statement of this sort in the literature nor observed anything similar in the rather abundant material investigated by me, I must leave this information alone.

abundant effusion of liquid, the lamellae of the shell come together and the body collapses. G. W. MÜLLER writes as follows with regard to this genus, 1895, p. 162: „Wie gesagt, fehlt der Schale jede Spur von Kalkablagerung, zudem tritt die feste Substanz der Leibeshöhlenflüssigkeit gegenüber sehr zurück, das specifische Gewicht kann kaum höher als des umgebenden Mediums sein. Flächenhafte Ausbreitungen fehlen so gut wie bei anderen Ostracoden, doch ist, wie gesagt, der Umfang im Verhältnis zur Körpermasse ein sehr großer, so daß man sich sehr wohl denken kann, daß das Thier ohne Zuhülfenahme seiner Ruder wie eine leichte Blase durch das Wasser treibt, ohne unterzusinken." To judge from the development of the second antenna (cf. the description of *G. Mülleri* below), the species of this genus seem, however, to be at the same time fairly good swimmers. — In most pelagian Ostracods, however, the specific weight has been rather moderately decreased.

By what means are the Ostracods with relatively high specific weight kept buoyant?

As in the case of the *Cladocera* we are here faced with the question: by what means are these forms kept buoyant?

To this question I must return the same answer as C. WESENBERG-LUND and R. WOLTERECK gave in the case of the *Cladocera*: chiefly by swimming. Thus, for instance, a non-swimming Halocyprid sinks to the bottom „like a stone". The natatory power of these forms is in point of fact very well developed; this is especially true of the Halocyprids; a very good illustration of this will be found in the information given below in the descriptions of species worked out in the special part of this work.

The shape of the shell of the planktonic Ostracods.

Contrary to what is the case in the planktonic *Cladocera* the shape of the shell in the planktonic Ostracods is subject to rather slight variation. The shells in the planktonic Cyprids (only a couple of species, mentioned by C. APSTEIN, 1907) and the Cypridinids are of about the same types as in the representatives of these groups that live on the bottom; thus all of them are quite without spines and large processes. Even most of the Halocyprids have shells of a very simple, moderately elongated shape without any large processes or spines. A number of representatives of this group are, however, characterized by more deviating types of shells. As examples of forms of the latter kind I may mention the following species:

Conchoecia daphnoides (C. CLAUS). This species is distinguished, as is shown by the accompanying fig. XVI, by an elongated fish-like type of shell, the posterior part of the shell is very much lengthened and flattened at the sides, the rostrum is long and wide.

Other species (e. g. *Euconchoecia aculeata* (T. SCOTT) var. *elongata* G. W. MÜLLER, see G. W. MÜLLER, 1906 a, pl. XXXII, fig. 21) resemble this type of shell but are less extremely developed. *Conchoecia caudata* G. W. MÜLLER is characterized by having the posterior dorsal corner of the right valve and the rostrum on both valves

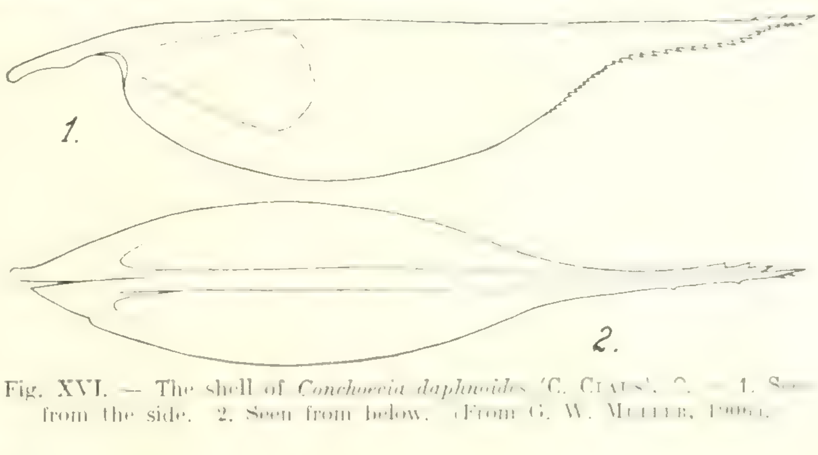

Fig. XVI. — The shell of *Conchoecia daphnoides* (C. CLAUS), ♀. — 1. Seen from the side. 2. Seen from below. (From G. W. MÜLLER, 1906 a.)

drawn out into very long spine-like processes situated in the same direction as the longitudinal axis of the body; see the accompanying fig. XVII.

In some species, e. g. *Conchoecia imbricata* (G. S. BRADY) and *C. symmetrica* G. W. MÜLLER (see fig. 1 of the latter species in the special part of this work) the rostrum is well developed and the posterior dorsal corner of both the right and the left valve is

Fig. XVII. — The shell of *Conchoecia caudata* G. W. MÜLLER, ♀, seen from the side. (From G. W. MÜLLER, 1906a.)

furnished with a spine-like process situated in the same direction as the longitudinal axis of the body but considerably shorter than in *C. caudata*; in addition some of these species have weak processes, pointing about in the same direction as the first-mentioned processes and corresponding to the mucrones in a number of *Cladocera*. The characteristic feature of all the processes so far mentioned is consequently that they point in the same direction as the longitudinal axis of the body. In others the shoulder ridges on the shell are differentiated as more or less powerful wing-like processes; these are found, for instance, in *Conchoecia alata* G. W. MÜLLER and *Halocypris cornuta* G. W. MÜLLER (see G. W. MÜLLER, 1906a, pl. XXIX, figs. 1 and 2 and pl. VIII, figs. 1 and 3).

Only in one species (*Thaumatocypris echinata* G. W. MÜLLER) do we find on the shell a number of spines pointing in different directions; see the accompanying fig. XVIII.

hat is the relation the shape of the ell to the principles nentioned above?

Fig. XVIII. — The shell of *Thaumatocypris echinata* G. W. MÜLLER, juv., seen from the side. (From G. W. MÜLLER, 1906a.)

What view are we to take of these processes and spines?

The only writer who has touched on this question is A. STEUER. In this author's work of 1910 they are denoted (p. 208) as buoyancy organs. It will soon, however, be obvious to anyone who studies these matters in detail that this explanation cannot be an adequate one. If we look, for instance, at the posterior part of the shell in *Conchoecia daphnoides*, we shall see that this is rather decidedly flattened at the sides, i. e. its horizontal section is rather slight. That the two pairs of spines in the genus *Thaumatocypris* cannot be explained as adaptations of buoyancy is shown quite clearly by their position, as they are not, as one would expect according to the buoyancy theory, both

placed in the horizontal plane in order to bring about an optimal increase in the horizontal projection; only one of them is in this plane — pointing almost straight forward — the other points almost straight downward; moreover, both pairs are concentrated on the anterior side of the shell.

By a closer investigation of the methods of swimming in the different Ostracod groups and by putting the results obtained in this inquiry into relation with the facts mentioned above I think we are enabled to understand this problem.

All Ostracods swim, at least as far as is known up till now, with the ventral side downwards. With regard to the methods in which the limbs function in swimming three different types can be distinguished:

Type I: There is only one representative of this type, namely the peculiar species *Thaumatocypris echinata*. The first antenna and the exopodite and endopodite of the second antenna co-operate in swimming; they all carry out downward and backward natatory strokes: in this the backward component is presumably the predominant one. (The species in question is, at least as far as we know so far, a deep-sea form; up till now it has only been caught once, with an open horizontal net at 1100 metres' depth. Observations as to its mode of swimming have certainly not been carried out hitherto on living material; the information given above is based exclusively on the structure and position of these limbs in pl. VI, fig. 3, G. W. MÜLLER, 1906a; all the same I have very little suspicion of the correctness of this information). Because of this in this genus, as in *Bosmina*, the body is pressed forward and upward in swimming; in order to bring about a progressive motion in a straight line it is thus necessary for other regulating factors to co-operate.

Type II: To this type belong Cypridinids and Halocyprids (except the genus *Thaumatocypris*). The first antenna and the endopodite of the second antenna do not take part in swimming. Only the second antenna, which — apart from the endopodite — has in these groups about the same structure as in the genus *Thaumatocypris*, functions in swimming. Unlike what is the case in the latter genus, the exopodite of this limb does not strike downwards and backwards in swimming, but outwards and backwards and somewhat downwards. By means of this a progressive motion in a straight line is produced. Alteration in the direction of motion is produced chiefly by increase and decrease of the force of the stroke in the exopodite of one side or the other and by twisting of the joint between the protopodite and the exopodite.

Type III: To this type belong only the Cyprids*. In swimming the first antenna strikes upward and backward and somewhat outward, the endopodite of the second antenna

* A variant of this type is found in the little family *Polycopidae*, which never has a pelagian life, as far as we know so far. (S. LO BIANCO mentions 1903, p. 152 a Polycopid in a plankton sample from a depth of 500 m. I can give no opinion about the value of this statement.) The only information that we possess as to the way in which these forms move is found in G. W. MÜLLER's work of 1894, p. 15. According to this writer these animals lie at the bottom for the most part. „Bisweilen erheben sie sich in kurzen Sprüngen vom Grund, schwimmen umher, jedoch wenig anhaltend, entfernen sich aber nie weit vom Boden." I have myself observed a specimen of *Polycope setigera* (see the special part of this work) living in an aquarium. The specimen was characterized by a straight-lined, progressive, comparatively swift and rather tenacious method of swimming. If it was disturbed it rose from the bottom and swam around with rapid natatory strokes for a long (sometimes several minutes) or short period, some-

downward and backward; in this way a progressive movement in a straight line is produced. Alterations in the direction of the movement are brought about chiefly by modification in the force of the strokes of one or more of these pairs of limbs.

If we combine these facts with those put forward on pp. 117 and 118 above, we obtain the following results:

I. In all planktonic Ostracods whose natatory limbs give the body a progressive movement in a straight line the shell has no processes that effect the direction of the motion. Such forms can be divided into two categories:

1) Those whose shells are quite without any large processes (Cypridinids, most of the Halocyprids* and all Cyprids).

2) Those whose shells have processes. These processes, however, either point in the direction of the movement (the longitudinal axis of the body) or are developed as lateral, symmetrically situated, wing-like formations (a number of Halocyprids).

II. In the only planktonic Ostracod *(Thaumatocypris echinata)* whose limbs do not give the body a progressive motion in a straight line the shell has processes that effect the direction of the motion by their position.

With regard to the processes that are found in the representatives of category I: 2 it seems to be beyond doubt that they function as buoyancy organs, as they all contribute more or less to increase the resistance of projection. But this does not seem to be the only funtion, perhaps it is not even the most important one. That this is the case seems to be shown partly by the fact that many of them do not have their maximum extension in the horizontal plane and partly because the forms in which they are developed are very strong swimmers. It is certain that they also function as stability organs. The way in which the posterior part of the shell and the rostrum point in *Conchoecia daphnoides* — see fig. XVI above — resembles as a matter of fact very much the arrangement of the metal plates that we see on submarines, plates that do not increase the buoyancy power in these vessels, but are designed to increase the stability of the motion (besides influencing its direction). A study of the shape of the shell in this species will show that it very closely approaches the ideal of a swift and stable swimming organism.

It thus remains to analyse the function of the spines on the shell of *Thaumatocypris echinata*. In this species, as is seen above, the mechanical arrangements for swimming resemble rather closely those of the genus *Bosmina*. The body is pressed forward and upward by the natatory strokes of the first and second antennae and for the same reasons as in the last-mentioned species a continual backward rolling movement would be produced if there were no special organs to prevent this. As in *Thaumatocypris* the natatory limbs are not,

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times in the neighbourhood of the bottom, sometimes higher up, sometimes right up to the surface of the water, about two decimetres from the bottom. In other words it acted in the aquarium in about the same way as most Cypridinids. A closer investigation showed that in swimming the first antennae struck upward and backward and somewhat outward, while the exopodite and endopodite of the second antenna and maxilla struck downward and backward and somewhat outward. Alterations in the direction of the motion were produced chiefly by modification of the force of the strokes in one or more of these limbs.

* To these belong the Polycopids too.

as in the case of the genera *Daphnia* and *Bosmina*, extended at the sides by a shell incisur, and as the body of this species is not, as in the last-mentioned species, suspended during swimming in these excentrically situated appendages, its rotatory axis is not, as in *Daphnia* and *Bosmina*, situated through the points of attachment of the appendages in question, but presumably just in front of the middle of the shell. The following factors prevent a backward rotation and render possible a progressive moton in a straight line. The most important factors are the two pairs of spines on the shell. These are situated, as is shown in fig. XVIII above, almost on the continuation of the radii of the almost circular shell, one pointing almost straight forward (perhaps somewhat downward), the other almost straight downward. As the axis of rotation is presumably situated, as is shown above, just in front of the middle of the shell, this position of the spines as a continuation of the radii of the shell seems to be almost ideal; during rotation the resistance of the water will be directed practically at a right angle to them. The resistance produced by the water against the progressive motion of the body obviously has no effect at all (or at any rate only an exceedingly slight one) on the forward- (or possibly slightly downward-) pointing pair of spines, and, on the other hand, it exerts practically a perpendicular influence on the downward-pointing pair of spines. Thus the lower pair of spines, like the first antennae in the genus *Bosmina*, operate like a pair of oars that are held out on one side of a moving boat. Just as the oars try to turn the boat in the direction in which they point, so the downward-pointing pair of spines in *Thaumatocypris* press the anterior part of the body downward, in other words this force, too, opposes the natatory strokes of the antennae, which give an upward turn to the body. Both pairs of spines thus make a passive resistance against a backward rotating movement; the lower pair of spines exercises, in addition, an active downward pressure on the anterior part of the body. One more factor seems presumably to help to prevent a backward rotating motion; this is the force of gravity, for, as is seen from pl. VI, fig. 2, G. W. MÜLLER 1906a, the centre of gravity in this species is presumably somewhat in front of the middle of the shell.

R. WOLTERECK's theory, which has, of course, by no means been unopposed* thus seems to me, as I have pointed out above, to obtain very strong support from the conditions in the Ostracod group. For scarcely anything more striking can be imagined than that of all the many planktonic Ostracod species, whose natatory limbs produce a progressive movement in a straight line, not a single one has processes that influence the direction of the motion, while the single form in which the natatory appendages do not produce a movement of this sort has a shell that is equipped with these processes.

All the same it seems to me that R. WOLTERECK — like many other investigators before him, when they have hit on a productive idea — is inclined to overestimate the importance of his new principle. A careful analysis of the importance of the more or less peculiar shapes of the different plankton organisms will probably show that the different principles, the principle of 1) buoyancy, 2) balance, 3) direction and 4) stability all play a very great part.

* See, for instance, O. OLOFSSON: „Studien über die Süßwasserfauna Spitzbergens." Zoologiska Bidrag från Uppsala, Bd. VI.

With regard to the spines that are found along a part of the margin of the shell in *Daphnia* (see the accompanying figure XIX) R. WOLTERECK writes as follows in his abovementioned work (p. 530): „Beide Stadien" (of development of these spines) „kommen z. B. am ventralen Schalenrand vor; und zwar sind hier die Dornen nach hinten gerichtet, während die ganz analogen Chitinfortsätze des Nackens am vorderen Winkel der Raute entstehen und dementsprechend nach vorn gerichtet sind. Aus dieser Verschiedenheit läßt sich die Funktion der so gerichteten Dornen wahrscheinlich ablesen: sie dienen dazu, das Zurückpendeln des ‚hüpfenden' Daphnienkörpers zu verlangsamen, indem sie dieser passiven Bewegung des Körpers viele kleine Flächen entgegenstellen und damit die Reibung vergrößern, also die Geschwindigkeit der Axendrehung vermindern, ohne doch die Vorwärtsbewegung allzusehr aufzuhalten. Das ist aber schon eine sekundäre oder tertiäre Funktion; die ursprüngliche Bedeutung der Chitinrauten und ihrer dornartigen Winkelverstärkungen ist wie bei anderen kriechenden Cladoceren die des Schutzes durch Festigung und Bestachelung des Chitinpanzers."

Fig. XIX. *Daphnia obtusa.* „Die verschiedenen Bildungsstellen von ‚pelagischen Fortsätzen'." From R. WOLTERECK, 1913.

I will not say anything in detail as to this hypothesis; it seems to me, however, not to be very probable. It should be pointed out that similar spines are found in young specimens of the species *Thaumatocypris echinata.* A number of these spines point in a direction that agrees with what this theory of WOLTERECK's necessitates, other do not; see fig. XVIII above.

CHAPTER IV.

BROOKS's Law.

With a general description of the post-embryonal development of a few species of Cypridiniformes and Halocypriformes.

Among the material of the Stomatopods that was collected during the Challenger expedition, 1873—1876, there was also a very rich collection of pelagian larvae. This caused W. K. BROOKS, who examined this material, to make an attempt to „unravel the tangled thread of the larval history" of this group, one of the most difficult problems that are presented in the study of post-embryonal development in the Crustacean group. W. K. BROOKS presented the result of these studies of his in a large work, „Report on the Stomatopoda, etc.", 1886. *Introductory notes.*

In attempting to identify the different larval stages this author made use of (1) the greater or less resemblance of the different individuals and (2) comparative measurements . . . . .

The method of comparative measurements seems to have given very good results, as is shown by the following statement on p. 5: „the measurements usually enabled me to decide with confidence whether a given larva does or does not belong to a certain series." From a general point of view the greatest interest of the investigation is perhaps centred in this point.

This method gave the best results in the study of four larvae that were caught at the same time off Cape St. Vincent. This author writes as follows about this, p. 5: „In a few cases these comparative measurements gave proofs of specific identity which could hardly be made more conclusive by rearing the larvae. Thus the lengths of the series of *Coronis* larvae shown in pl. XIII, figs. 1—8 are as follows, and if the length of the first stage be successively multiplied by five-fourths of itself, and this number by five-fourths of itself again, and so on, we obtain the series of numbers given in the second line, and as it is not conceivable that an accidental collection of larvae should exhibit such exact conformity to a numerical law, we may feel certain that these larvae are genetically related, that they belong to one species or else to closely related species, and that the series is consecutive, with the exception of one missing stage before the last.

4,16 mm.	5,29 mm.	6,49 mm.	. . . . . .	10,21 mm.
4,16 „	5,20 „	6,50 „	8,13 mm.	10,16 „

The specimens that were examined were measured from the tip of the rostrum to the tip of the telson. I. e. „the length of the larvae increases uniformly at each moult by one-fourth of its length before the moult" (p. 105).

Have we here a principle that can be applied universally? Do the larvae increase by a constant percentage of their length in other Crustacean groups as well?

W. K. BROOKS gives no answer to these questions. And almost all other investigators have, curiously enough, left this question almost entirely untouched, although it seems to merit the greatest possible attention. If we are concerned here with a universal principle, a law, we shall have discovered a method of investigation that would to a very great extent increase the possibility of determining with certainty the species and relative age of the larvae of the *Crustacea*.

F. H. HERRICK in his important work „The American Lobster", 1896, has — apparently quite independently of W. K. BROOKS — made use of the principle described above in order to calculate approximately the number of moults of the shell that a lobster of a given, arbitrary length has undergone.

As F. H. HERRICK's exposition of this point seems particularly interesting I shall give a verbal quotation of it from the work mentioned. Thus we read, pp. 96, 97: „In table 24 I have recorded the molts of eight lobsters varying from 5½ to 11¼ inches in length. The actual increase in length varied from 1 inch to 1½ inches, and the increase percentage (that is, the ratio which the increase bears to the total length before molting) from 6,66 to 18,18. The average percentage of increase in all these cases is 12,01.

Table 24. — Increase in the length of lobsters at the time of molting.

No.	Date.	Sex.	Length before the molt.	Length after the molt.	Increase in length.	Increase per cent.
			Inches	Inches	Inches	
1	Oct. 22, 1890	Female	5½	6½	1	18,18
2	Oct. 29, 1890	Male	11	12	1	9,09
3	Nov. 6, 1890	do.	7¼	8½	¾	9,68
4	Nov. 10, 1890	—	9	10½	1½	16,66
5	Nov. 11, 1890	—	7½	8	½	6,66
6	June 8, 1891	do.	9 9/32	10½	1 7/32	13,13
7	July 13, 1891	do.	11¼	12½	1¼	11,11
8			6½	7¼	¾	11,54
	Average					12,01

The increase per cent in the growth of larvae is recorded in table 34. Sixty-six molts belonging to more than half as many individuals are tabulated. The average increase per cent in length in stages 2 to 10 varied from 11 to 15,84. The average for stages is 13,67; for individuals, 13,89. These facts seem to warrant the conclusion that the increase percentage in the young is very similar to that of the adult, a result of considerable interest. The average length of the young lobster during its first ten molts is given in the following table. The data are taken partly from table 34:

Table 25. — Actual length of lobsters during the first ten molts.

Number of molt or stage	Average length. mm.	Extremes in length. mm.		Number of lobsters examined.
1	7,84	7,50	to 8,03	15
2	9,20	8,3	10,2	47
3	11,1	10	12	79
4	12,6	11	14	64
5	14,2	13,4	15	15
6	16,1	15	17	12
7	18,6	18	19,5	4
8	21,03	19,75	22	5
9	24,5	24	25	2
10	28,03	26,6	29,5	3

The rate of growth expressed by the average of lengths in the second column of table 25 implies an increase per cent of about 15,3 instead of 13,67 (the average increase in stages recorded in table 34). Assuming the average length of the first larva to be 7,84 (the average of 15 individuals, table 25), and allowing the increase in length at each molt to be 15,3 per cent of the length before molting, we would have the following series of lengths attained during the first thirty stages.

Table 26. — Estimated length of lobsters during the first thirty molts.

Stage.	Length. mm.	Stage.	Length. mm.	Stage.	Length. mm.
1	7,84	11	32,55	21	135,17
2	9,04	12	37,54	22	155,86
3	10,42	13	43,28	23	179,70
4	12,02	14	49,90	24	207,20
5	13,86	15	57,53	25	238,90
6	15,98	16	66,34	26	275,45
7	18,42	17	76,49	27	317,59
8	21,24	18	88,19	28	366,16
9	24,49	19	101,68	29	422,21
10	28,23	20	117,24	30	486,81

The agreement between the lengths of the first ten larval stages as actually determined by F. H. HERRICK and given in Table 25 and the calculated lengths must — when one considers the comparatively small number of specimens measured — be described as striking.

These facts seem, of course, to a great extent to support the idea that the principle used by W. K. BROOKS for the Stomatopods is of universal application.

H. Fowler's in-...stigations on ...tracods, Homarus and Carcinus.

The only writer who has dealt in more detail with this problem is G. H. FOWLER in a work, 1909, on the plankton Ostracods collected during the cruise of H. M. S. Research in 1900. The result of this study is particularly noteworthy, as G. H. FOWLER was of the opinion that he could show that the above-mentioned principle applied throughout the whole Halocyprid group. It was also applied to *Cypridina (Macrocypridina) castanea* G. S. BRADY, *Homarus americanus* MILNE EDWARDS and *Carcinus maenas* LEACH.

...rooks's law as formulated by G. H. Fowler.

On p. 224 of this work G. H. FOWLER suggests that this principle should be called „BROOKS's Law", „in honour of one of the most ingenious of recent naturalists" and he formulates this law in the following general way: „During early growth, each stage increases at each moult by a fixed percentage of its length, which is approximately constant for the species and sex."

Halocypris.

The following examples of the applicability of this „law" in the Halocyprid group are given in this work:

Halocypris globosa (C. CLAUS).

	Stage I. Mean 2,51								Stage II. Mean 1,54						Stage III Mean 0,95		Stage IV. Mean 0,61		Stage V. Mean 0,40
Length in mm.:	2,8	2,7	2,6	2,5	2,4	2,3	2,2	2,1	1,7	1,6	1,5	1,4	1,3	1,2	1,0	0,9	0,7	0,6	0,4
Number of ♀ measured:	6	12	107	83	22	22	8	5	6	13	1	8	1	1	4	4	2	9	1

Total specimens measured: 315 ♀.

„Considering the scarcity of the smaller specimens, the response of the mean to BROOKS's law is good: — 0,37 × 1,62 = 0,59; 0,59 × 1,62 = 0,95; 0,95 × 1,62 = 1,539; 1,54 × 1,62 = 2,49" (p. 278).

Conchoecia spinifera (C. CLAUS).

	Stage II. Mean 2,12.							Stage III. Mean 1,44.			Stage IV. Mean 0,98.	
Number of ♀ measured:	1	12	17	4				8	12		4	1
Length in mm.:	2,3	2,2	2,1	2,0	1,9	1,8	1,7	1,5	1,4	1,1	1,0	0,9
Number of ♂ measured:				1	2	9	4	2	11	1	2	
				Stage II. Mean 1,80.				Stage III. Mean 1,41.		Stage IV. Mean 1,03.		

Total specimens measured: 59 ♀ + 32 ♂.

„The females, although few, respond well to BROOKS's law: — 0,98 × 1,47 = 1,44; 1,44 × 1,47 = 2,11. There were only three males at Stage IV., a number which cannot be

expected to yield a satisfactory mean; the mean is too low to fit with the ratios between Stages III. and II.: 1,08 × 1,30 = 1,40; 1,40 × 1,30 = 1,82" (p. 275).

Conchoecia procera G. W. MÜLLER.

		Stage II. Mean 1,16			Stage III. Mean 0,9		Stage IV. Mean 0,64		?Stage V. Mean 0,5
Number of ♀ measured:	1	39	27		8		4	5	1
Length in mm.:	1,3	1,2	1,1	1,0	0,9	0,8	0,7	0,6	0,5
Number of ♂ measured:		6	35	4	14		2	1	
		Stage II. Mean 1,11			Stage III. Mean 0,9		Stage IV. Mean 0,66		

Total specimens measured: 85 ♀ + 62 ♂.

„Taking the females first: — 0,64 × 1,36 = 0,87; 0,87 × 1,36 = 1,18. On morphological grounds the specimen at 0,5 appeared to belong to an earlier stage than those at 0,6 and 0,7; and by the same growth-factor this stage would have a mean at 0,47. — In the males there is an overlap of the Stages II. and III. at 1,0 . . . . the numbers are too small for accuracy: 0,7 × 1,26 = 0,88; 0,88 × 1,26 = 1,10." (p. 271).

Conchoecia Haddoni G. S. BRADY and A. M. NORMAN.

	Stage I. Mean 2,72.						Stage II. Mean 1,66.		Stage III. Mean 1,1.	Stage IV. Mean 0,66.				?Stage V. Mean 0,4.
Length in mm.:	3,0	2,9	2,8	2,7	2,6	2,5	1,7	1,6	1,1	0,8	0,7	0,6	0,5	0,4
Number of ♀ measured:	2	1	4	3	6	1	2	1	1	1	6	3	1	3

Total specimens measured: 37 + ?3 = 40 ♀.

„In the females the usual proportions between the means appear, the second place of decimals being somewhat vague, presumably owing to the paucity of specimens. Thus, 0,62 × 1,64 = 1,01; 1,01 × 1,64 = 1,656; 1,66 × 1,64 = 2,72. The observed mean of 0,66 for Stage IV. is perhaps too high, and the growth-factor employed a little larger than the true factor" (p. 265).

Only 5 males were measured, representing two different stages.

Conchoecia hyalophyllum C. CLAUS.

	Stage I. Mean 2.3.			Stage II. Mean 1.58.				Stage III. Mean 1.07.			
Number of ♀ measured:	1		?1	8	24	13	2	1	8	5	
Length in mm.:	2.5	2.3	2.1	1.7	1.6	1.5	1.4	1.2	1.1	1.0	0.7
Number of ♂ measured:		1			3	27	3		7	1	1
		Stage I. Mean 2,3.				Stage II. Mean 1.5.			Stage III. Mean 1.08.		Stage IV. Mean [illegible]

Total specimens measured: 62 + ?1 + 43 ♂.

„The ratios for BROOKS's law come out sufficiently clearly, although the total numbers are small, and in spite of the difficulty of separating this species from *magna* at the lower stages. Taking the means as a basis for calculating:

♀ 1,07 × 1,48 = 1,58; 1,58 × 1,48 = 2,33.

♂ 0,77 × 1,40 = 1,078; 1,08 × 1,40 = 1,51; 1,50 × 1,40 = 2,10" (1,51 × 1,40 = 2,11), (p. 266).

Conchoecia rhynchena G. W. MÜLLER.

	Stage II. Mean 2,47.				Stage III. Mean 1,60.			Stage IV. Mean 1,04.			Stage V. Mean 0,70.		
Length in mm.:	2,6	2,5	2,4	2,3	1,7	1,6	1,5	1,1	1,0	0,9	0,8	0,7	0,6
Number of ♀ measured:	2	8	2	2	1	2	1	3	1	1	2	1	2

Total specimens measured: 28 ♀.

„In the females the reaction to a growth-factor is very close: — 0,7 × 1,54 = 1,07; 1,04 × 1,54 = 1,60; 1,60 × 1,54 = 2,46. As there are only three males to represent Stages III. and IV., it is useless to discuss their growth-factor." (p. 272).

Conchoecia imbricata (G. S. BRADY).

	Stage II. Mean 2,34									Stage III. Mean 1,50						Stage IV. Mean 0,96			Stage V. Mean 0,66	
Number of ♀ measured:	3	7	12	1	1					2	17	2				11	6		2	1
Length in mm.:	2,5	2,4	2,3	2,2	2,1	2,0	1,9	1,8	1,7	1,6	1,5	1,4	1,3	1,2	1,1	1,0	0,9	0,8	0,7	0,6
Number of ♂ measured:					2	5	1		1	1	7	5				14				
					Stage II. Mean 2,01				Stage III. Mean 1,48							Stage IV. Mean 1,0				

Total specimens measured: 65 ♀ + 36 ♂.

„Now, taking the mean lengths of the females at the different stages: — 0,62 × 1,56 = 0,96; 0,96 × 1,56 = 1,497; 1,50 × 1,56 = 2,34 . . . . The males are much fewer and therefore respond less accurately: — 1,0 × 1,45 = 1,4; 1,4 × 1,45 = 2,03." (pag. 225).

Conchoecia daphnoides C. CLAUS.

	Stage I. Mean 3,08.										Stage III. Mean 1,2.
Length in mm.:	3,5	3,4	3,3	3,2	3,1	3,0	2,9	2,8	2,7	2,6	1,2
Number of ♀ measured:	1	1	5	41	15	31	9	5	2	1	1

Total specimens measured: 112 ♀.

„In addition to the numerous specimens of Stage I. there was a single female specimen of (apparently) Stage III.: this with the aid of a slide-rule enables one to make an empiric guess at the mean of Stage II. With a growth-factor of 1,6 for females it appears that 1,2 × 1,6 = 1,92; 1,92 × 1,6 = 3,07; and we may fairly presume that the mean of Stage II. will be a little more or less than 1,9" (p. 263).

In a footnote on the same page the author adds: „Since this was written, I have measured the two specimens of „*lacerta*“ taken by the „R e s e a r c h“ in the Faeroe Channel (Proc. Zool. Soc. 1903, p. 122) and now in the British Museum. They were females of 2,0 mm. in length.“

With regard to other species of the family *Halocypridae* that are dealt with in this work we may note the following:

In the case of three species, *C. elegans* G. O. SARS, *C. rotundata* G. W. MÜLLER and *C. curta* J. LUBBOCK it was impossible for the author to set satisfactory average lengths for the different stages because the curves for these were overlapping, p. 263: „the differences in length between the successive stages are so small that measurement to only one place of decimals does not bring out clearly the boundaries between stages . . . .“ The average values obtained by approximation agreed very well, however, with BROOKS's law. Cf. pp. 263, 274 and 261.

Conchoecia magna C. CLAUS, p. 268, gave less satisfactory results. G. H. FOWLER himself tries to explain this by the impurity of the material; no attempt is made to fit this species in with BROOKS's law.

It is true that three stages both of males and females were found of *Conchoecia loricata* (C. CLAUS), p. 267, but the specimens of Stage III were „too few to give satisfactory growth-factors“. Only four specimens of this stage were caught, two males and two females. The following average lengths were found: — Females: Stage I, 2,58 mm., Stage II 2,0 mm., Stage III, 1,3 mm. Males: — Stage I, 2,31 mm., Stage II, 1,75 mm., Stage III, 1,2 mm., These average figures give the following coefficients of growth: — 2,58 : 2,0 = 1,29; 2,0 : 1,3 = 1,54. — 2,31 : 1,75 = 1,32; 1,75 : 1,2 = 1,46.

With regard to *Conchoecia ametra* G. W. MÜLLER p. 259 the individuals that were caught were also too few to give satisfactory growth-factors; three stages of both sexes were found.

	Stage II.		Stage III.		Stage IV.	
Stated means in mm.:	3,30	3,10	2,3	2,16	1,42	1,6
Number of specim. measured:	11	4	1	3	5	1

From these means the following growth-factors are arrived at: — 3,30 : 2,3 = 1,43; 2,3 : 1,42 = 1,6. — 3,10 : 2,16 = 1,43; 2,16 : 1,6 = 1,35.

Of three species probably only two stages were captured: these species were: *Conchoecia inermis* (C. CLAUS), p. 267, *C. brachyaskos* G. W. MÜLLER p. 259, and *C. spinirostris* C. CLAUS p. 276.

As to the last-mentioned species G. H. FOWLER remarks p. 276: „MÜLLER has described and figured (Naples Monograph, p. 183, pl. XXXIV, figs. 1, 2, 3, 5) [illegible] of this species, of which the two older at least were males; . . . . Measured without the rostrum, they were 0,33, 0,44, 0,59, 0,79 mm. Now 0,33 × 1,35 = 0,44; 0,44 × 1,35 = 0,589 (0,59); 0,589 × 1,35 = 0,79; these are therefore related as in other species.“

Some species were represented by one stage only, viz. *Archiconchoecia cucullata* (G. S. BRADY), p. 279, *Conchoecia pusilla major* G. W. MÜLLER, p. 272, *C.* [illegible] G. W. MÜLLER, p. 240 and *C. tyloda* G. W. MÜLLER, p. 253.

This writer's investigations with regard to *Macrocypridina*, *Homarus* and *Carcinus* gave the following results:

Macrocypridia.

Cypridina (Macrocypridina) castanea G. S. BRADY.

Only five specimens were recorded; they measured 6,0, 4,0, 1,9, 1,8, and 1,8 mm. „Apparently three stages, I., II., and IV., were represented in the five specimens; with a growth-factor of 1,5, the lengths 1,8, 2,7 (missing), 4,0, and 6,0 are related as in the other species" (p. 279).

H[illegible]

Homarus americanus MILNE EDWARDS.

This investigation is based on the statements as to length given by F. H. HERRICK in the work of 1896 quoted above. The result of this study quite coincides on the whole with the result previously obtained by F. H. HERRICK, cf. p. 125 above. It is noteworthy, however, that G. H. FOWLER pointed out that there must be a difference between the early, larval moults and the moults at a more advanced age, p. 280: „If a lobster continued to moult at the same brief intervals, and to grow by the same increment as did HERRICK's larvae, it would be $10\frac{1}{2}$ inches long at the end of its first year (instead of 2–3 inches), and in five years would be a dangerous monster of portentous size."

Carcinus.

Carcinus maenas LEACH.

G. H. FOWLER based this investigation on measurements of the greatest breadth of the carapaces that were thrown off by eleven individuals kept in aquariums; the measurements were previously published by H. C. WILLIAMSON, 1903. „The observed breadths seemed ... to fall into groups round obscure medians." Although the average values for these classes of breadths seem to be anything but certain, they agree in quite an amazing way with BROOKS's Law. In the following table the left row represents „the means of these vaguely indicated groups", the right row „the successive products, by an empirically-found growth-factor, of means starting from 4,80, the lowest observed mean of the series" (p. 281).

4,80	4,80 × 1,27 = 6.09
6,05	6,09 × 1,27 = 7,73
7,75	7,73 × 1,27 = 9,81
9,61	9,81 × 1,27 = 12,45
12,65	12,45 × 1,27 = 15,81
16,02	15,81 × 1,23 = 19,44
19,50	19,44 × 1,23 = 23,91
23,89	23,91 × 1,23 = 29,40
29,30	29,40

As will be seen from the above table G. H. FOWLER was of the opinion that in this case too a smaller growth-factor could be observed for older stages. For more details see this author's account, pp. 280, 281.

Criticism of G. H. Fowler's exposition.

One of the reasons why I submitted this „law" to a fresh test was that a number of the proofs given by G. H. FOWLER seemed to be altogether too good.

As is seen from the account given above, out of all the Halocyprids of which two or three stages had been found by G. H. FOWLER all except three, *Conchoecia magna*, *C. loricata* and *C. ametra*, agreed very well with BROOKS's law.

In the case of *C. magna* G. H. FOWLER tried, as will be seen above, to explain this deviation by assuming that the material investigated was not pure. This explanation is certainly correct. Stage I (= *Conchoecia macrocheira* G. W. MÜLLER) and Stage II (= *C. magna* C. CLAUS) are (as is pointed out in the special part of the present treatise) certainly two quite distinct species.

In the case of the two other of these three species the cause of the deviation is to be sought, according to the same author, in the small number of individuals that were investigated. Whether this explanation is correct for *C. ametra* I must leave undecided; it is to be noted that the growth-factors obtained from the average lengths that were actually observed vary a good deal; cf. above. With regard to *C. loricata* it ought to be pointed out that the material investigated was presumably impure. Stage I (= *Conchoecia ctenophora* G. W. MÜLLER) and Stage II (= *C. loricata* [C. CLAUS]) are presumably to be regarded as two closely related species; cf. the special part below.

All the other of these species agreed very well with BROOKS's law, as has been mentioned above; these species were: *Halocypris globosa*, *Conchoecia spinifera*, *C. elegans*, *C. procera*, *C. rotundata*, *C. curta*, *C. Haddoni*, *C. hyalophyllum*, *C. rhynchena*, *C. imbricata* and *C. daphnoides*.

In spite of this agreement it is probable that the material of some of these species was not pure. Thus in the case of *Conchoecia curta* Stage I (= *C. stigmatica* G. W. MÜLLER) and Stage II (= *C. curta* J. LUBBOCK) certainly represent two well differentiated forms. The same is true of Stage I and Stage II of *C. hyalophyllum*: Stage I = *C. lophura* G. W. MÜLLER, Stage II = *C. hyalophyllum* C. CLAUS. Nor is it impossible that a mixture has also taken place in the case of the larvae of *C. rhynchena*, as this writer points out on p. 248 that „it is probable that *C. kampta* or *C. tyloda* may be the oldest stage of this species". It seems to be beyond all doubt that *C. kampta* G. W. MÜLLER and *C. tyloda* G. W. MÜLLER are forms that are well differentiated both from each other and from *C. rhynchena*. Both these species occur in the material investigated by G. H. FOWLER — according to this author — only as mature individuals. Were there also larvae of these two species among the larvae of *C. rhynchena*? For the reasons why *C. stigmatica*, *C. curta*, *C. lophura*, *C. hyalophyllum*, *C. rhynchena*, *C. kampta* and *C. tyloda* represent different forms I shall only refer here to what is written in the special part of this work.

For Stage I and Stage II of *C. rotundata* the reader is referred to what is written about this species in the special part of this work. The result of G. H. FOWLER's investigation of *C. daphnoides* and *Halocypris globosa* seems also to merit further verification. The length of the first stage of *C. daphnoides* varied from 2.6—3.5 mm; only a single specimen of Stage III was found and yet the law agreed perfectly!

These instances ought to show better than many words the necessity of proceeding with the greatest caution in applying the „law“.

The weak point in the proofs obtained by this author from the genus *Conchoecia* is that they are based on a material that was caught at a region so rich in similar and closely-related species as the Bay of Biscay. In earlier stages it is almost or quite impossible to distinguish closely related species of this genus with certainty by means of morphological characters. Investigations of this kind ought, of course, to be based either on material in aquariums or, preferably, on material from localities at which there are no forms that are closely related to the species investigated, and the material should be submitted to a very careful morphological investigation.

On the other hand it must be definitely pointed out that some of the examples given by G. H. FOWLER strongly support BROOKS's law as it is formulated by this writer. Among these forms there is especially *Conchoecia imbricata*; this form is very characteristic and even during the earliest larval stages it seems to be distinguishable with certainty from other forms found in the region investigated. The result of this author's measurements of *Cypridina (Macrocypridina) castanea*, which is mentioned above, also seems particularly noteworthy, but the material of this species was unfortunately too sparse for the result obtained to have any decisive importance.

Ostracods.

I now pass on to give an account of some observations made by myself, which may to some extent help to increase our knowledge of this „law“. For the terms given to the different larval stages see p. 60 above, the chapter on general terminology; for the method of measuring the length of the shell see p. 13 above of the introduction.

Cypridiniformes.

Sub-order: *Cypridiniformes.*

Cypridina (Doloria) pectinata.

All the individuals whose measurements are given below were caught at the same time and at the same place: S. A. E. station 60, the eastern exit of the Beagle Channel, Tierra del Fuego, 100 m. deep. It seems certain that all these specimens belonged to this species, partly because of morphological reasons, partly because this species seems to be the only or at any rate quite the dominant representative of the sub-family *Cypridininae* in this region.

Six free-living larval stages could be distinguished:

General description of the larval stages: —

Stage I: —

Male: This is very like the mature stage. Shell: Average length, 2 mm.; length: height = about 1,5: 1. The first antenna is of about the same type as that of the mature female; it is quite without secondary sexual characters. Second antenna: The endopodite is of about the same type as that of the mature male but has a rather decided larval appearance; its end joint is somewhat straighter and it is obvious that it cannot be folded back on its predecessor; cf. fig. 12 of this species. The posterior limbs differ from those in the mature stage only by having a more larval appearance and having the bristles

somewhat fewer and less differentiated. The penis is small and simple and of an embryonal appearance, resembling somewhat the simple type in the genus *Philomedes*. The furca has only nine claws, which in most cases decrease fairly uniformly in length the more proximally they are situated. The lateral eyes, the median eye and the rod-shaped organ are well developed.

Female: This too is very like the mature stage. Shell: Average length, 2,1 mm.; length: height = about 1,5: 1. All the limbs are well developed; the posterior ones are of about the same type as in the male of this stage. The furca has eleven claws — i. e. the same number as in the mature stage — decreasing in most cases fairly uniformly in length the more proximally they are situated. The lateral eyes, the median eye and the rod-shaped organ are well developed. The character by means of which this stage is most easily distinguished from the mature stage — apart, of course, from the size — is the larval appearance of the tissues.

Stage II: — I was not successful in distinguishing with certainty between males and females in this stage by means of dissection; this may be due to the fact that the sexual characters have not yet begun to develop or that all the specimens investigated were actually females. Shell: Average length, 1,75 mm.; length: height = about 1,5: 1. With regard to the limbs it need only be mentioned here that they were all well developed, but they had, especially the posterior ones, a still more larval appearance than in the preceding larval stage; thus the cleaning limb — although it had proportionately about the same size as in the mature stage — is armed with only about half the number of cleaning bristles. Each furcal lamella is armed with only nine claws, in most cases decreasing fairly uniformly in length the more proximally they are situated. The lateral eyes, the median eye and the rod-shaped organ are well developed.

Stage III: — Shell: Average length, 1,4 mm.; length: height = about 1,5: 1. All the limbs are developed in this larval stage too, but the cleaning limb is only represented by an upward pointing appendage that is certainly rather long, but very slightly differentiated; it has no cleaning bristles at all. The sixth limb, although of about the definitive shape, is of a decidedly larval type; along the ventral margin of its end joint there are, for instance, only six bristles, three anteriorly on the joint and three posteriorly; the former are separated from the latter by a sharply marked gap. Other limbs also have about a definitive shape, while at the same time they present features that are even more larval than in the preceding stage. Each furcal lamella is furnished with eight claws, of which the fourth is relatively short and weak, the others decreasing almost uniformly in length the more proximally they are attached (note that only one specimen of this stage was investigated; among larvae belonging to Stage I and Stage II single individuals were also observed with the fourth furcal claw comparatively short and weak). The lateral eyes, the median eye and the rod-shaped organ are well developed; the median eye, however, has rather weak pigmentation.

Stage IV: — Shell: Average length, 1,2 mm.; length : height = about 1,5 : 1. In this larval stage too all the limbs are present, the cleaning limb exists, however, only

as a very short, upward pointing peg, without bristles. The sixth limb has a more markedly larval type than in the preceding stage; it is represented only by a rounded, unjointed or almost unjointed, weakly two-lobed little plate, of about the same type as is shown in fig. 22, pl. 34, G. W. MÜLLER, 1894; the proximal joint usually has only one bristle; the distal one has no bristles, only numerous stiff hairs. Each furcal lamella has six or seven claws, of which the two distal ones dominate rather decidedly over the others; cf. fig. 13 of this species in the special part of this work. The lateral eyes, the median eye and the rod-shaped organ are rather well developed, the median eye, however, is only rather slightly pigmented.

Stage V: — Shell: Average length, 1 mm.; length : height = 1,4 : 1. While the preceding larval stages were characterized by a shell whose length was somewhat greater in proportion to its height than in the mature female, this stage, like the following, shows a shell in which the proportion between length and height is about the same as in the mature female. The seventh limb is quite absent. The sixth limb is developed only as a small undifferentiated, downward pointing peg with stiff hairs. The other limbs have about the definitive fundamental type, but have a somewhat more larval appearance than in the preceding stage — especially in the case of the bristles. Each furcal lamella has only five or six claws, the two distal of which dominate over the others even more strongly than in the preceding stage. The lateral eyes are large and fairly well developed, the median eye and the rod-shaped organ are developed but have a decidedly larval appearance; the median eye has scarcely any pigment.

Stage VI: — This is the youngest free-living larval stage that I found. Shell: Average length, 0.9 mm.; length : height = about 1.4 : 1. Even in this stage the shell has about the same type, when looked at from the side, as in the mature stage. It agrees fairly closely with the preceding stage; the sixth limb is almost as much developed here as in this stage.

The next stage that I found had not yet left the brood chamber. Its length was only 0.6—0.7 mm. The lateral eyes were large and well pigmented but had no ommatids developed. The limbs were scarcely developed. Possibly it ought really to be termed an embryo.

Although the length classes that were observed were thus in a number of cases rather closely related to each other morphologically, there can be no doubt that each of them represents a moult.

G. W. MÜLLER in his Ostracod monograph, 1894, gives a short description of the three youngest larval stages of *Cypridina mediterranea* O. COSTA. According to this author the larva of this species leaves the brood chamber as soon as it has been hatched from the egg. The youngest free-living larval stage has about the same shape of shell as the mature specimens, only „etwas kürzer und höher". The five anterior limbs have about the definitive type, but the fifth limb „mit wesentlich geringerer Anzahl von Borsten und zahnartigen Gebilden". The sixth limb is already formed, but is very simple; it has a „bereits an die definitive Gestalt erinnernde Form".* and has no bristles at all. The furca has five claws, the two distal of which dominate strongly over the others.

* Pl. 34, fig. 21 shows a type very like that described by me above for Stage V.

The following larval stage is very like the preceding one, but the fifth limb is somewhat more differentiated. The sixth limb is distinctly two-jointed; its proximal joint has one bristle, its distal joint none. The furca has the same number of claws as in the preceding stage, but the difference between main claws and secondary claws is less striking.

The next larval stage is characterized by the fact that the sixth limb has almost a definitive shape, but it has comparatively few bristles; according to pl. 34, fig. 24 the end joint has only five bristles, three anterior ones and two posterior ones; the cleaning limb is developed as a short, unjointed, upward pointing appendage without bristles. The furca has eight claws.

With regard to the further development of this form this author writes as follows, p. 185: „Ueber die weiteren Entwicklungsstadien kann ich für *Cypridina mediterranea* keine Angaben machen. Nach Untersuchungen an *Pyrocypris* dürften noch verschiedene Häutungen folgen. Die Veränderungen würden, abgesehen von einer allgemeinen Größenzunahme und einer Vermehrung der Borsten an verschiedenen Gliedmaaßen, in einer Streckung des Putzfußes bestehen, verbunden mit dem zunächst nur andeutungsweisen Auftreten von Gliedern und dem Erscheinen einzelner Borsten an der Spitze."

According to C. CLAUS, 1865, p. 153, the youngest larval stage (which is still in the brood chamber) is quite without the two posterior pairs of limbs.

It follows from this that the results obtained by these authors agree very well, on the whole, with what I observed above for *Cypridina (Doloria) pectinata*. There are, however, some small differences to note: thus, for instance, in the third larval stage of *Cypridina (Vargula) mediterranea*, which seems to correspond to Stage III of *Cypridina (Doloria) pectinata*, the cleaning limb is very short. Stage V and Stage VI seem to have been confused by G. W. MÜLLER; they seem to correspond to the youngest larval stage given by this author.

Measurements: —

Sixty free-living individuals of *Cypridina (Doloria) pectinata* from the above-mentioned station were measured. The results of these measurements are given in fig. XX.

The column 17—21 comprises the embryos in the brood chamber; when these leave the mother they probably have a length of about twenty divisions. A mature male measured 62 divisions. The mature females are represented by columns 73—76 and 77.

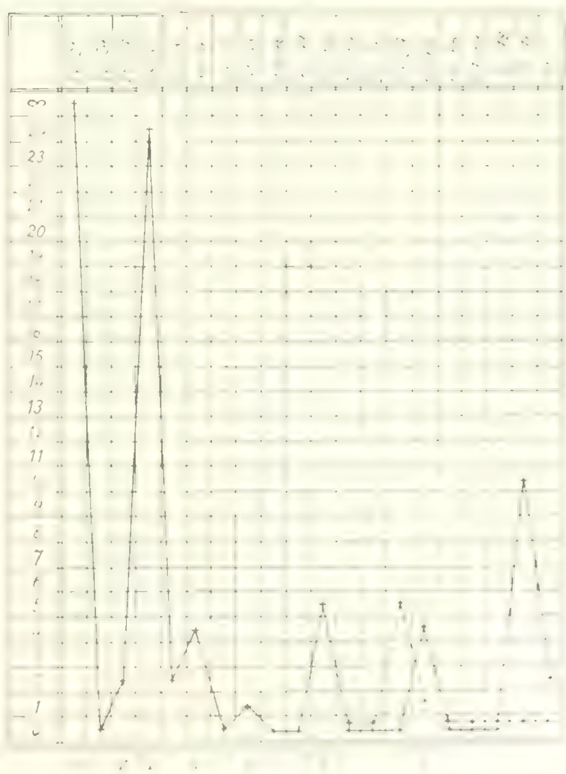

Fig. XX. — Curves showing the results of my measurements of the lengths of the shells of a number of larvae of *Cypridina (Doloria) pectinata* from Tierra del Fuego. [illegible] = males. The abscissa represents the lengths of the shells expressed in divisions of a micrometer (29—30 divisions = 1 mm.): the ordinate represents the number of specimens measured.

The growth factor determined empirically = 1,22.

The average lengths calculated theoretically are:

	Stage VII	Stage VI	Stage V	Stage IV	Stage III	Stage II	Stage I	Mature
	20d	24d	29d	35d	43d	52d	63 d	76d
Actual lengths:	17—21d	25—27d	28—30d	34—36d	41—43d	50—52d	60—63d ♀, 57d ♂	73—77d ♀, 62 ♂

Cypridina (Vargula) norvegica.

All the specimens of this species that are dealt with below, mature males and females and larvae, were collected at Lofoten at the same locality and on the same occasion by Professor G. O. SARS. There seems to be no doubt that all the specimens investigated really belonged to this species. Only two representatives of the sub-family *Cypridininae* seem to exist at the west coast of Norway, namely *Cypridina (Vargula) norvegica* and *C. (V.) megalops*. There seems to be no great difficulty in distinguishing these forms even during the larval stages; see for instance, the endopodite of the second antenna.

Five free-living larval stages could be distinguished.

General description of the larval stages: —

In the case of the four youngest of these five larval stages I did not succeed in distinguishing with certainty between males and females by means of dissection. Even in the last larval stage it is almost impossible to distinguish the two sexes except by means of a close investigation of the rudiments of the sexual organs. In the mature stage there is, as will be seen in the special part of this work, a close agreement between males and females; differences are merely to be found in the shape of the shell, the first antenna, the mandible and the furca. These differences are almost entirely absent even in the oldest larval stage. In this stage the shape of the shell is almost the same in both sexes, closely resembling that of the mature male, i. e. with a distinctly marked posterior corner; the first antenna is practically alike in both sexes and the mandible as well. In this larval stage, as in Stages II—IV, furcal claws nos. 2 and 4 are united to the lamella, as on the furca of the mature female; claw no. 3 is, like the others, well marked off basally. In Stages I—IV, as in the mature individual, furcal claw no. 3 is somewhat shortened and weakened. In the youngest stage observed by me, Stage V, the two distal furcal claws dominate very decidedly over the proximal ones, from which they are also separated by a rather well marked gap. In this stage furcal claw no. 2 is united basally to the lamella; the other furcal claws are well marked off basally. The number of the furcal claws increases by one for each stage: Stage V has 4, Stage IV has 5, etc.

Apart from this these larval stages agreed very well with the above-described five oldest larval stages of *Cypridina (Doloria) pectinata*. It seems to me quite certain that they correspond to five moults.

Measurements: —

From the above-mentioned locality 72 specimens of this species were examined. The measurements of the shells gave the following results:

M a t u r e f e m a l e s:

1 specimen with a shell-length of 3,65 mm.		Mean 3,46 mm.
5 specimens ,, ,, ,, ,, ,, 3,6 ,,		
3 ,, ,, ,, ,, ,, ,, 3,5 ,,		
4 ,, ,, ,, ,, ,, ,, 3,45 ,,		
4 ,, ,, ,, ,, ,, ,, 3,4 ,,		
3 ,, ,, ,, ,, ,, ,, 3,35 ,,		
2 ,, ,, ,, ,, ,, ,, 3,3 ,,		

M a t u r e m a l e s:

10 specimens with a shell-length of 3,3 mm.	Mean 3,27 mm.
3 ,, ,, ,, ,, ,, ,, 3,25 ,,	
1 specimen ,, ,, ,, ,, ,, 3,2 ,,	
1 ,, ,, ,, ,, ,, ,, 3,1 ,,	

L a r v a l s t a g e s:

S t a g e I: Furca with 8 claws (males and females).

4 specimens with a shell-length of 2,9 mm.	Mean 2,81 mm.
2 ,, ,, ,, ,, ,, ,, 2,85 ,,	
4 ,, ,, ,, ,, ,, ,, 2,8 ,,	
3 ,, ,, ,, ,, ,, ,, 2,7 ,,	

S t a g e I I: Furca with 7 claws.

3 specimens with a shell-length of 2,4 mm.	Mean 2,32 mm.
5 ,, ,, ,, ,, ,, ,, 2,3 ,,	
1 specimen ,, ,, ,, ,, ,, 2,2 ,,	

S t a g e I I I: Furca with 6 claws.

1 specimen with a shell-length of 2,0 mm.	Mean 1,91 mm.
5 specimens ,, ,, ,, ,, ,, 1,9 ,,	
1 specimen ,, ,, ,, ,, ,, 1,85 ,,	

S t a g e I V: Furca with 5 claws.

1 specimen with a shell-length of 1,55 mm.	Mean 1,55 mm.

S t a g e V: Furca with 4 claws.

1 specimen with a shell-length of 1,35 mm.	Mean 1,31 mm.
4 specimens ,, ,, ,, ,, ,, 1,3 ,,	

G r o w t h - f a c t o r, found empirically = 1,21.

Estimated lengths of the last five larval stages:

2,81 : 1,21 = 2,32; 2,32 : 1,21 = 1,91; 1,91 : 1,21 = 1,58; 1,58 : 1,21 = 1,3
(2,81) (2,32) (1,91) (1,55) (1,31) (actual means).

Length of Stage I, 2,81 mm. × 1,21 = 3,4 mm.

Philomedes (Ph.) globosa.

All the specimens of this species dealt with below, mature females and males as well as larvae, were collected during the Swedish Greenland Expedition, 1899, all on the same occasion, the 17th of July, and at the same place, lat. 74° 10′ N., long 20° 8′ W., depth 25—40 m. It seems to me certain that they all really belong to this species, partly for morphological reasons and partly because at the locality in question probably only this species of this genus is found. Cf. this species in the special part below.

Six free-living larval stages could be distinguished.

General description of the larval stages: —

Stage I: —

Male: As has already been pointed out by preceding authors (cf. the special part of this work), this differs strikingly from the mature male. Shell: Average length, 2,4 mm. It agrees entirely with the shell of the mature female. The first antenna, the mandible, the maxilla and the fifth, sixth and seventh limbs are also of the same type as those of the mature female; the posterior limbs have perhaps a somewhat smaller number of bristles. Second antenna: The protopodite and exopodite have the same appearance as in the mature female, but the bristles on the four distal joints of the exopodite are primarily short and without natatory hairs; for the endopodite see the figure of this organ of this species in the special part below. The furca has eight claws, which decrease fairly uniformly in length and strength the more proximally they are situated. The lateral eyes are almost of the same size as in the mature male, but are only very slightly pigmented.

Female: This agrees completely with the male of this genus except in the sexual characters, the endopodite of the second antenna and the lateral eyes: in the latter characters it resembles the mature female, but is more larval in type.

Stage II: —

Male: Shell: Average length, 1,9 mm. The endopodite of the second antenna is considerably smaller and much less differentiated than in Stage I; its second joint has only two bristles. The posterior limbs have somewhat fewer bristles and the lateral eyes are considerably smaller than in the preceding stage. The furca has eight claws. Otherwise this stage agrees with Stage I.

Female: This agrees completely with the male of this stage except in the sexual characters, the endopodite of the second antenna and the lateral eyes; in the latter characters it resembles the female of Stage I, but is more larval in type.

In the following larval stages I did not succeed in distinguishing with certainty between males and females by means of dissection.

Stage III: — Shell: Average length, 1,5 mm. In this stage too all the limbs are present. The seventh limb, however, is only represented by a long, unjointed, upward pointing appendage, which is quite without bristles. Sixth limb: The end joint is furnished ventrally with only about eight bristles. Other limbs are also furnished with fewer bristles than in the preceding stages, but, like the sixth limb, they have about the definitive type. Each

furcal lamella has seven claws, which decrease fairly uniformly in length and strength the more proximally they are situated.

Stage IV: — Shell: Average length, 1,2 mm. In the third larval stage the bristles on the surface of the shell are somewhat fewer than in the first and second stages; this decrease is still more striking in this stage, the surface of the shell being almost smooth. The sixth limb is represented by a rounded, unjointed or almost unjointed, two-lobed plate; cf. fig. 20 of this species in the special part of this work; the proximal lobe is only furnished with one bristle, the distal one has no bristles, armed only with long, stiff hairs. The seventh limb is also found; it is represented, however, only by a small, undifferentiated process pointing upwards. Each furcal lamella has six claws, which decrease fairly uniformly in length the more proximally they are situated.

Stage V: — Shell: Average length, 1 mm. Even in this stage the shell has about the same shape as that of the mature female. The dorsal margin is, however, somewhat more uniformly rounded. The sixth limb is less flattened and is simple, peg-like, without bristles, furnished only with stiff hairs. The cleaning limb is quite absent. The anterior limbs are also of a decidedly larval type, with a very much reduced number of bristles, but yet of about the definitive type. Each furcal lamella is armed with from three to five claws, of which the two distal ones dominate very decidedly over the others in size and strength; the proximal ones are very weak, spine-like; cf. fig. 21 of this species in the special part. The rod-shaped organ and median eye are well developed as in the preceding stages, but have a very pronounced embryonal character.

This was the youngest freely living stage I found.

Stage VI: — This is hypothetical, as no specimens have been found so far. The average length of the shell, as calculated theoretically, = 0,83 mm.

Stage VII: — This is still in the brood chamber of the mother. Shell: Average length, 0,7 mm. It is oval; the rostral incisur is broad and rather shallow. The sixth and seventh limbs are absent. The other limbs are developed with about the definitive type; the posterior ones have, however, rather few bristles.

Measurements: —

142 specimens of this species from the above-mentioned station were measured. The measurements of the lengths of the shells gave the following result as shown graphically, fig. XXI.

It follows from this figure that the specimens investigated could be divided into six distinct classes of length. In each class the length differs by about three divisions. The class 80—82 consists of mature females (there were no mature males in this sample), the others consisted of larvae. I succeeded in distinguishing males and females only in the two oldest larval stages, as is shown above; both sexes appeared to have the same length of shell. Thus classes 54—56 and 68—70 include both males and females.

The growth-factor as determined empirically was 1,23,

With this growth-factor the following average lengths are to be expected theoretically:

Stage V	Stage IV	Stage III	Stage II	Stage I	Mature individuals.
29 d	36 d	44 d	54 d	66 d	81 d
28—30 d	34—36 d	43—45 d	54—56 d	68—70 d	80—82 d. Actual lengths.

In the sample that was investigated there was, as is shown above, no free-living larval class younger than that of 29d. But the latter is probably not to be taken as the youngest free-living stage. In a number of females larvae were observed which were apparently ready to leave the brood chamber. These larvae were only 0.9 mm. (= 20 d) long. If, using BROOKS's law, we divide 29 d by 1.23 and the quotient again by 1.23, we shall obtain, of course, the theoretical average lengths of the two next youngest stages. According to this method of calculation these stages ought to have an average length of 24 d and 20 d respectively. In other words the younger of these two stages ought theoretically to have the same average length as that which was determined empirically for those larvae that are about to leave the brood-chamber of the mother. This stage ought consequently to be presumably taken as the seventh; on the other hand the larval stage representing the sixth was quite absent in this sample.

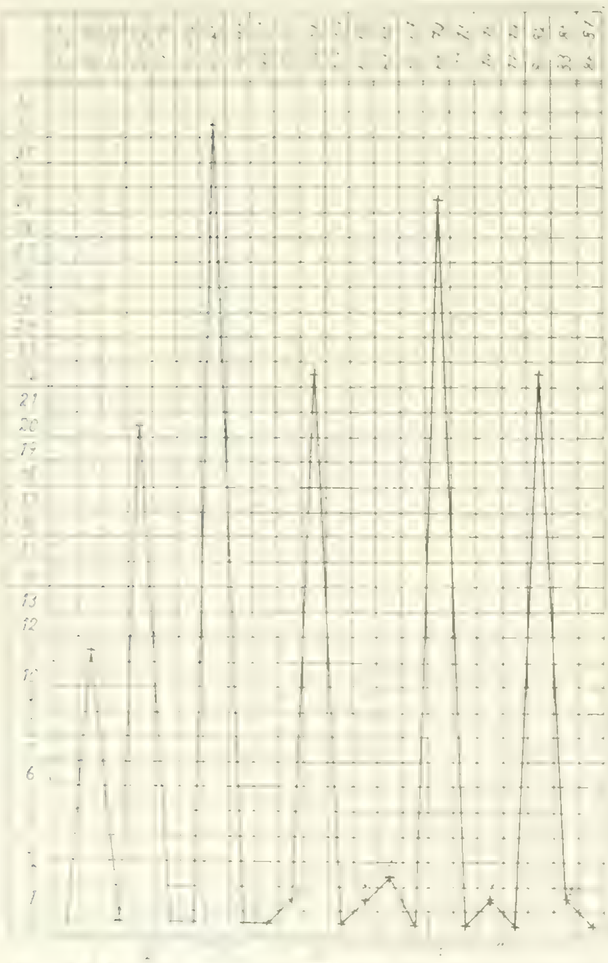

Fig. XXI. [illegible] the results of my measurements of the lengths of the shells of [illegible] number of specimens of *Philomedes globosa* from Greenland. The abscissa represents the lengths of the shells expressed in divisions of a micrometer (29 divisions = 1 mm.); the ordinate represents the number of specimens measured.

Corresponding classes of length were also found in other samples, but in these the absolute measurements were different with different external conditions. In all these samples, however, the younger larval stages were represented still more sparsely than in the one dealt with above.

Although, as in *Cypridina (Doloria) pectinata* and *Cypridina (Vargula) norvegica*, the classes of length that were observed were, at least in a number of cases, very near each other, it seems to me certain that each represents a moult; the agreement with the post-embryonal development of the preceding species is too great to leave any doubt.

The agreement between the development of the larvae in *Philomedes globosa* and *Cypridina (Doloria) pectinata* is, as is shown above, very great. When to this it is added that quite a similar post-embryonal development is observed in *Cypridina (Vargula) norvegica*, it ought not to be too bold to assume that the post-embryonal developed is, on the whole, quite similar in all representatives of the family *Cypridinidae* (perhaps in all the species belonging to the sub-order of *Cypridiniformes*).

All representatives of this family presumably go through seven postembryonal moults. At any rate the number of moults is not subject to variation in this family, a result that is of the greatest importance in judging of BROOKS's law. *The number of postembryonal moults in this group.*

Sub-order: *Halocypriformes.* *Halocypriformes.*

Conchoecia elegans.

All the individuals described and measured below were caught at the same time and at the same locality, on the 1st. of Feb., 1911 off the west coast of Sweden, S. Koster, at a depth of 125 m.

Only two larval stages could be distinguished with certainty.

General description of the larval stages: —

Stage I: —

Male: Shell: Average length, 1,74 mm. It is of about the same type as that of the mature female; cf. fig. 5 in the special part. The shoulder ridge is somewhat less distinctly marked. The rod-shaped organ is of about the same type as in the mature female, shows about the same variation and projects almost the same distance beyond the first antenna as in this sex. First antenna: The e-bristle is, as in the mature female, about twice as long as the four other distal bristles; the latter are subequal or else the b- and d-bristles are somewhat shorter than the a- and c-filaments; the b- and d-bristles are rounded distally and somewhat narrower than the a- and c-filaments, and unlike these they are annulated; the bristle on the second joint is straight. Second antenna: This is like that of the mature female; the c- and d-bristles are developed; laterally and somewhat distally of the latter there is a rather powerful peg, see fig. 9 of this species in this work. The sixth limb has the same number of bristles as in the mature stage; of the bristles of the end joint the middle one is somewhat longer than the total length of the two distal joints, the two others are about a third or a quarter shorter; the remaining bristles are more like those of the mature female than those of the mature male. The seventh limb has the definitive type. The penis is about of the same type as shown in fig. 17, pl. 34, G. W. MÜLLER, 1894. The furca has seven claws, which decrease fairly uniformly in length and strength the more proximally they are situated.

Female: Shell: Average length, 1,5 mm. It is of the same type as that of the male in this stage. The rod-shaped organ and the limbs are about the same as in the mature female. The furca is like that of the male in this stage.

Stage II: —

Male: Shell: Average length, 1,13 mm. It is relatively somewhat higher than in the preceding stage; length : height = about 2,25 : 1. The shoulder ridge is scarcely developed at all. The postero-dorsal corner of the shell has a point that projects rather less, but the latter is furnished with secondary teeth as in the preceding stage. The rod-shaped organ is somewhat more slender than in the preceding stage. The first antenna has quite the same type as in the female. The second antenna is the same as in the preceding stage, but one of the c- and d-bristles is very small. Sixth limb: The three bristles of the end joint have about the same relative lengths as in the mature female; as in the last

stage, these lengths vary somewhat. The seventh limb is of the definitive type with two distal bristles, one long and one short one. The number of bristles on the other limbs is only very slightly decreased. The penis consists of two very small embryonal processes. Each furcal lamella has six claws, which decrease fairly regularly in length and strength the more proximally they are situated.

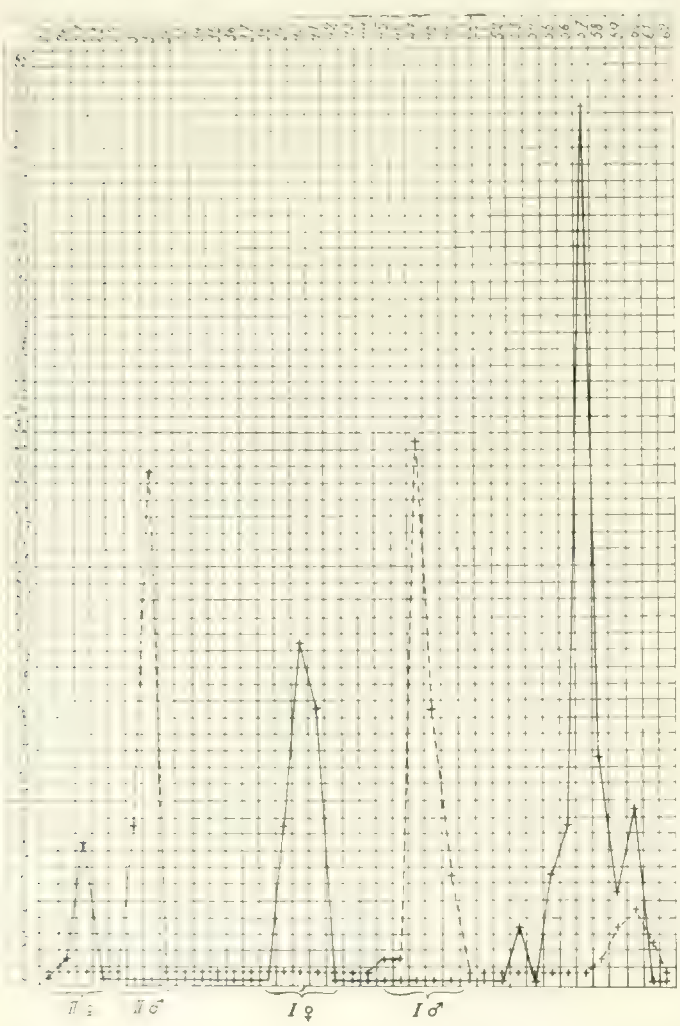

Fig. XXII. — Curves showing the results of my measurements of the lengths of the shells of a number of specimens of *Conchoecia elegans* from Koster, west coast of Sweden. — = the females; --------- = the males. The abscissa represents the lengths of the shells expressed in divisions of a micrometer (27 divisions = 1 mm.); the ordinate represents the number of specimens measured.

Female: Shell: Average length, 1,00 mm. It is of the same type as in the male of this stage; the secondary teeth on the postero-dorsal spine are, however, somewhat less developed. The rod-shaped organ is similar to that of the male in this stage. The limbs are about the same as in the female of the preceding stage. The furca is similar to that of the male in this stage.

There cannot be the slightest doubt that these two larval stages really belong to *C. elegans*, as in the region from which these specimens were obtained there are, except the species mentioned, only two forms of the genus *Conchoecia*, namely *C. obtusata* G. O. SARS and *C. borealis* G. O. SARS; there is no risk of confusion with either of these species during the two oldest larval stages.

It seems also to be quite certain that they represent two moults. The agreement with the observations of C. CLAUS and G. W. MÜLLER is complete; cf. the latter author, 1894, pp. 183, 184.

Measurements: —

258 specimens of this species from the station mentioned were investigated and measured. The measurements of the lengths of the shells gave the following result, as shown graphically in fig. XXII.

The above table shows that the specimens could be divided into three distinct male and three female classes according to the lengths of their shells. The male class 58—61 and the female 53—60 represent mature specimens.

Average lengths, expressed in divisions of the micrometer: males, mature = 60 d, Stage I = 47 d, Stage II = 30,7 d. Females, mature = 57 d, Stage I = 40,2 d, Stage II = 27 d.

G r o w t h - f a c t o r: Males: — 60 : 47 = 1,277; 47 : 30,7 = 1,53

Females: — 57 : 40,2 = 1,41; 40,2 : 27 = 1,5.

Sub-order: *Cypriformes*.

Cypriformes.

In this group eight post-embryonal larval stages have been observed, according to the investigations of C. CLAUS and G. W. MÜLLER. The number of moults seems to be constant within the whole group. The development is very similar in the different families; cf. G. W. MÜLLER, 1894, pp. 175—183.

The species of this group investigated by me have a post-embryonal development that corresponds exactly to that which has been established by C. CLAUS and G. W. MÜLLER for other forms in this group. Because of this I have omitted to give descriptions of the observed classes of length below.

*Krithe sp.**

All the specimens of this species dealt with below were collected at the same locality on the same occasion: the Bay of Villefranche (Maritime Alps, France), at a depth of 95 m. on January 19th, 1916. A considerable number consisted of empty shells. This fact does not, however, make their determination less certain, as this species differs greatly from all other species from the locality mentioned by the shape of its shell. The Ostracod fauna from this locality was not at all rich in species, and I had obtained a thorough knowledge of it by means of a large number of dredgings.

M e a s u r e m e n t s: —

428 specimens of this species from the locality mentioned were examined and measured. The measurements of the lengths of the shells gave the following result, which is presented graphically in fig. XXIII.

As this table shows, the specimens that were investigated may be divided into six distinct classes according to the length of their shells. Of these class 43—48 represents mature individuals.

The males and the females were of about equal lengths.

It is practically quite certain that each of the five larval classes of length really represents a moult. A decided argument in favour of this is the fact that I succeeded in observing in an aquarium how individuals of one class attained the length of the next largest length class by one moult. Two females in Stage I, with shells 36 and 36,5 divisions long respectively, attained a length of about 44 divisions after one moult. One larva of Stage II, with a shell about 28,5 divisions long, had after one moult a length of about 35 divisions. On all the occasions the moult occurred from two to five days after the beginning of the aquarium life.

Average lengths for the six classes of length mentioned above:

Mature = 45,1 d; Stage I = 36,12 d; Stage II = 28,8 d; Stage III = 23,23 d; Stage IV = 19,2 d; Stage V = 15,5 d.

* This species will be described in more detail in a following part of this work.

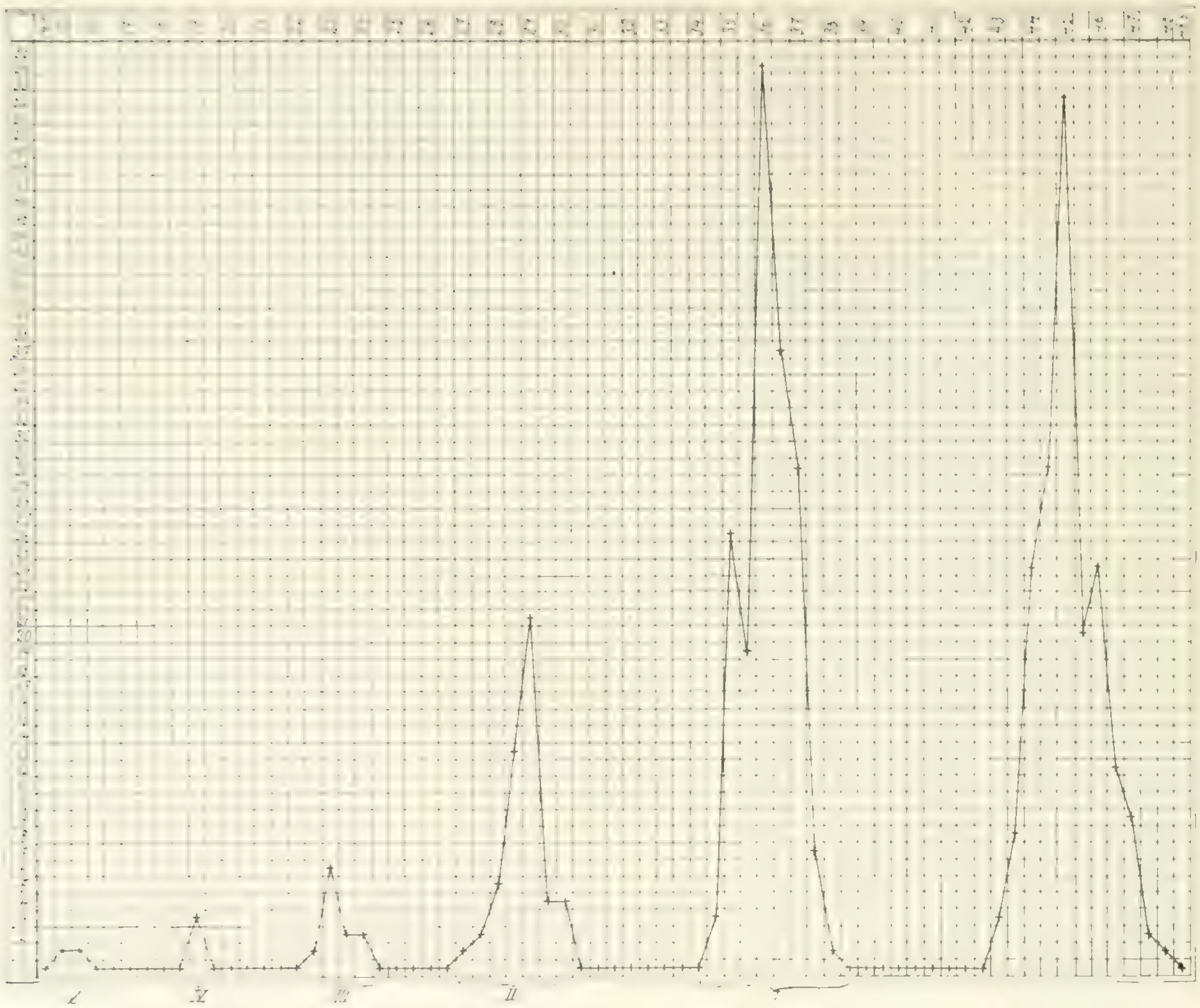

Fig. XXIII. Diagram to show the results of my measurements of the lengths of the shells of a number of specimens of *Krithe sp.* from Villefranche-s-mer. The abscissa represents the lengths of the shells expressed in divisions of a micrometer (64 divisions = 1 mm.); all the measurements are rounded off to the nearest half division. The ordinate represents the number of the specimens measured.

The relation between the different succeeding stages, i. e. the growth-factors, is as follows:

45,1 : 36,12 = 1,248
36,12 : 28,8 = 1,254
28,8 : 23,23 = 1,24
23,23 : 19,2 = 1,21
19,2 : 15,5 = 1,24.

How do these examples stand in relation to Brooks's law?

How do the examples given by me above stand in relation to BROOKS's law, if the latter is taken as formulated by G. H. FOWLER, 1909, p. 224?

Examples in favour of this law.

Cypridina (Doloria) pectinata: The agreement between the lengths as calculated theoretically and those actually found is striking. The males increase, however, comparatively less

at the transition from Stage II to Stage I and between the latter stage and the mature stage. 57 d: 51 d = 1,108; 62 d: 57 = 1,109.

Cypridina (Vargula) norvegica: In this the agreement between the theoretically calculated lengths and those actually observed may be said to be surprisingly great. Here too the males increase somewhat less rapidly at the change to the mature stage; 3,27: 2,81 = 1,16.

Philomedes globosa: The agreement between the theoretically calculated lengths and those actually observed is striking; only the oldest larval class of length is somewhat longer than it ought to be theoretically.

Krithe sp.: In the case of this species too it can be said that the growth at the different moults is very similar. The relations between the mature stage and the oldest larval stage, between the latter and the next oldest larval stage, between this and Stage III and between Stage IV and Stage V are really very similar, 1,24 — 1,254; average, 1,245. Only at the transition from Stage IV to Stage III does the growth seem to have been less, the growth-factor being 1,21.

In passing I may point out here that a smaller number of specimens of the investigated material of this species might have given a considerably more striking agreement with BROOKS's law. Growth-factor = the average found above, 1,245.

$$
\begin{aligned}
& & & 15{,}5 \\
15{,}5 &\times 1{,}245 &=& \ 19{,}29 \\
19{,}29 &\times 1{,}245 &=& \ 24{,}0 \\
24{,}0 &\times 1{,}245 &=& \ 29{,}88 \\
29{,}88 &\times 1{,}245 &=& \ 37{,}2 \\
37{,}2 &\times 1{,}245 &=& \ 46{,}3.
\end{aligned}
$$

In other words, if we use this growth-factor, we obtain theoretically average lengths, all of which are within the boundaries of the length classes that were established empirically.

In passing I may point out here that other Ostracod species as well, of which unfortunately I had at my disposal only a rather slight material, showed a good agreement with BROOKS's law. I shall only mention a single one of these here, as it gives a rather good illustration of the applicability of this law.

In a tube of Ostracods from the Falkland Islands that I investigated there were, besides mature specimens of a *Cythereis* species* not previously described, a number of larvae which, in spite of a number of differences, were, on fairly good grounds, assigned to the above species. At the locality in question the mature specimens of this species were characterized by great constancy with regard to the length of the shell; mature males 0,80—0,83 (usually 0,83) mm. Mature females 0,77—0,79 (usually 0,78) mm. A number of the larvae in question measured 0,49—0,51 (average 0,50) mm., others 0,40 mm. For anatomical reasons I concluded that they represented Stage II and Stage III. The growth-factor was consequently 1,25.

$$
\begin{aligned}
& & & 0{,}40 \\
0{,}40 &\times 1{,}25 &=& \ 0{,}50 \\
0{,}50 &\times 1{,}25 &=& \ 0{,}625 \\
0{,}625 &\times 1{,}25 &=& \ 0{,}781.
\end{aligned}
$$

* To be described in a later part of this work.

The agreement between the last number and the length of the mature female is of course striking. There were, however, no larvae with shells 0,625 mm. long in this tube. In order, if possible, to be able to complete the chain of development of this species, I went, however, to the sample of sand etc. from which the specimens dealt with above had been picked out. In this I found two complete individuals, clearly larvae in the last larval stage, and one valve which certainly belonged to this species; these individuals had shells from 0,62—0,65 mm. in length. The largest specimen was a male; 0,65 × 1,25 = 0,8125, i. e. about the length of the mature male.

This example seems to show that in the case of species with a relatively constant length of shell we may expect a far-reaching agreement even in those cases where only a small material is present.

Growth-factor.

We must note the very slight difference in the growth-factor in different species: *Cypridina (Doloria) pectinata* = 1,22, *Cypridina (Vargula) norvegica* = 1,21, *Philomedes globosa* = 1,23, *Krithe sp.* = 1,245.

Exceptions to the law of Brooks. G. H. Fowler.

If thus a number of cases agree particularly well with BROOKS's law, there are, on the other hand, a great many exceptions to this law to be noted. It is certain that the law is by no means absolute. It obviously applies only with a number of restrictions and with certain assumptions.

This has already been pointed out by G. H. FOWLER himself. This investigator pointed out, 1909, p. 258, that it seemed to him possible that not only the average lengths and the growth-factors employed by him but also „the law itself, as here phrased" are approximative. As is seen above this author has shown that the same growth-factor does not presumably apply to all stages in large forms with many moults *(Homarus, Carcinus)*. He states on p. 258 that this is presumably true „even in *Ostracoda* of small size and few stages". We find this latter assumption true in the case of the males of *Cypridina (Doloria) pectinata* and *Cypridina (Vargula) norvegica*. On the other hand there are no such cases in G. H. FOWLER's own examples. *Krithe sp.* shows obvious variation with regard to the growth-factor. The larvae of *Conchoecia elegans* can certainly be divided into well distinguished categories of length — contrary to what G. H. FOWLER observed — but they do not permit of any simple application of BROOKS's law. Males and females have different growth-factors at the change from Stage II to Stage I and at the change into the mature stage. It is to be noted that the growth-factor is about the same for males and females at the transition from Stage II to Stage I. I have also observed other cases that do not conform to this law, for instance *Asterope Grimaldi*, a form that I caught in rather large numbers in the harbour at Monaco.

We must note that in the cases in which there was agreement with BROOKS's law all the specimens that were investigated were caught at the same locality and on the same occasion. On the other hand the water in the harbour at Monaco is subject to great variations and the same is true, though not to such a great extent, of the water in the Bay of Villefranche.

On pp. 227 and 228 G. H. FOWLER points out (1909) that it will probably appear that the growth-factor is not quite identical for the same species and sex „at every

geographical position and sea-climate". It remains as a fact that the same species has different sizes at different localities. Thus the specimens of *Philomedes globosa* measured by me were only 2,4—2,6 mm. at Skager Rack while the same species attained a length of 2,9—3,1 mm. at Greenland. This difference in length is not due to the species undergoing a different number of moults before maturity under different external conditions. The number of larval moults in the Cypridinid group seems to be constant for every species, as is shown above. Corresponding classes of length were found at the different localities, but the absolute measurements are different; cf. *Philomedes globosa*. This difference in length really seems often to be accompanied by a difference in the growth-factor. Unfortunately my material was not large enough to work out a definite answer to this problem by means of it. A fact that supports, however, the idea that there is sometimes an alteration of the growth-factor is that the embryos in the brood-chamber of large individuals are often not essentially larger than those in small individuals. (In the large individuals, on the other hand, the number of embryos is often larger than in small individuals.)

Summary of the results of my investigation of this problem.

The final result of my investigations is thus that the growth-factor during the post-embryonal development of the Ostracods is presumably an inherited factor, but it is rather strongly influenced by external circumstances; in addition in a number of species it is not quite the same during the whole post-embryonal development. It thus seems as if BROOKS's law, as formulated by G. H. FOWLER, 1909, p. 224, needs a not inconsiderable modification. Before it is re-formulated, however, it will be necessary to investigate a still larger material; moreover the importance the abundance of nourishment, temperature and other external conditions for the rapidity of growth must first be studied.

In spite of this the law even as formulated at present seems to be very useful. G. H. FOWLER himself has estimated it correctly when he says, 1909, p. 258: „On the other hand, I have little doubt that the law as phrased on p. 224 is a sufficiently accurate weapon for the zoologist to use in combination with the morphological evidence, even if the words „fixed percentage" may require revision at the hands of the mathematician".

SPECIAL PART.

Order: Ostracoda.

For synonymy, see G. W. MÜLLER, 1912, p. 1.

Diagnosis and description: — Cf. G. W. MÜLLER, 1912, pp. 1–4.

Historical: — C. VON LINNÉ was the first to denominate scientifically a form belonging to this group of animals, and although still earlier investigators, even the Nestors of microscopy, SWAMMERDAM and LEEUWENHOEK, had already been occupied to some extent with the study of *Entomostraca* — and in this could of course scarcely avoid coming across some species belonging to the group in question — yet this master of science was, at least if we are to judge from the results to be seen in the literature, the first to make an attempt, even though a groping one, at a closer investigation and description of an Ostracod. — O. F. MÜLLER states in 1772 that H. BAKER in his work „Microscope made easy", 1743, had already mentioned an Ostracod; this statement is, however, due to a mistake. *Linné.*

In his „Fauna Suecica", 1746, LINNÉ gives on p. 344 a species called: „*Monoculus antennis capillaceis multiplicibus, testa bivalvi*", with, one must admit, a very superficial description, and this form, certainly a Cyprid, occurs again in the author's „Systema Naturae", 10th ed. 1758, p. 635 and in „Fauna Suecica" of 1761, p. 498, under the name of *Monoculus conchaceus*. In „Systema Naturae", 1758, are also given two other Ostracod species; these also presumably Cyprids, *Monoculus lenticularis* and *M. telemus*, which are also only superficially described.

Even in the later part of the 18th century we come across a number of works which mention, among other things, forms belonging to *Ostracoda*; examples are H. BAKER, 1753, L. JOBLOT, 1754, M. F. LEDERMÜLLER, 1760, G. de RIVILLE, 1760, N. PODA, 1761, É. L. GEOFFROY, 1762, O. F. MÜLLER, 1772, 1776, 1785, C. de GEER, 1778, J. F. GMELIN, 1788, and B. E. MANUEL, 1792. – Most of these comparatively numerous works, however, did little ro nothing to increase the knowledge of this group of animals. Only O. F. MÜLLER's two last works, especially „Entomostraca seu Insecta Testacea", 1785, an extensive work for his time, indicate a real step forward. In the last-named work MÜLLER gave two genera, *Cypris* and *Cythere*, the former with eleven species living in fresh water, the latter with five marine species. By this classification the foundation may be said to be laid for the great

and certainly quite natural families *Cypridae* and *Cytheridae*. — G. de RIVILLE's work, a small article entitled „Mémoire sur la mer lumineuse" is noteworthy because in it are to be found the first account and — for his time comparatively good — figures of a species belonging to the sub-order *Cypridiniformes*. The author, however, gives no name to the form investigated by him, nor does he try to classify it; he merely points out that it seems to him „ressembler . . . . des Puces d'eau"; his work does not seem to have given much stimulus to new investigations; on the contrary it seems until recently to have been forgotten.

During the earlier part of the 19th century, a rather great number of writers devoted themselves to some extent to the study of the Ostracods, but they too obtained comparatively insignificant results. As examples may be mentioned such works as those of L. A. G. BOSC, 1802, K. A. RAMDOHR, 1805, 1808, L. JURINE, 1820, H. E. STRAUS, 1821, A. G. DESMAREST, 1825, P. A. LATREILLE, 1829, C. M. A. KOCH, 1837, H. MILNE EDWARDS, 1840, A. PHILIPPI, 1840, and G. ZADDACH, 1844. — Although most of the works during this period were purely classificatory, devoted principally to describing species, yet as far as the natural classification of the Ostracod group is concerned, scarcely any results were obtained beyond those arrived at in O. F. MÜLLER's work 1785. — H. MILNE EDWARDS' and A. PHILIPPI's above-mentioned works are, however, noteworthy because in them were for the first time scientifically denominated and classified forms belonging to the sub-order *Cypridiniformes*; in the former of these two works the genus *Cypridina* was established, in the latter the genus *Asterope*; the descriptions of these genera were, however, exceedingly incomplete and, in addition, contained serious errors, so that our knowledge of the forms belonging to them was but slightly increased. L. JURINE's „Histoire des Monocles", 1820, may be said to be the most important of these works, at least as far as comprehensiveness is concerned. In it are described no less than 18 fresh-water Cyprids, and in addition it contains rather important statements about the oecology of these forms, especially about the conditions under which they propagate. With regard to the acuteness of both morphological and oecological observations, however, H. E. STRAUS seems to be quite as capable as or even somewhat superior to the last-mentioned investigator. The value of this author's above-mentioned work „Mémoire sur les Cypris", 1821, is also increased by the fact that it was in it that the Ostracods were first separated from the other *Entomostraca* as an independent group.

About this STRAUS writes as follows l. c. pp. 33, 34: „Les deux valves qui recouvrent le corps des cypris avoient fait illusion aux naturalistes, qui trouvant des parties semblables chez les daphnia, les lynceus, etc., ont réuni ces divers genres dans une même famille, quoique la différence de leur organisation soit très-considérable; je crois cette différence assez grande, non-seulement pour considérer les cypris comme appartenant à une famille distincte de celle que j'ai établie sous le nom de Daphnides, mais même pour devoir former un ordre nouveau dans lequel je place encore les cythere." On p. 58 in this work the name „Ostrapodes" is proposed for the new group.

In passing we may discuss a problem of nomenclature which is rather important. We see that *Ostrapoda* is the name first given to this group. Ought it to be kept?

The first time in literature that we come across the name *Ostracoda*, which is nowadays practically quite the accepted name for this group, is in P. A. LATREILLE's work „H i s t o i r e n a t u r e l l e d e s C r u s t a c é s e t d e s I n s e c t s", 1802. The „ordre quatrieme" of *Entomostraca*, under which the author includes the genera *Lynceus*, *Daphnia*, *Cypris* and *Cythere*, thus both O s t r a c o d s in the modern sense and *Cladocera*, is called *Ostrachoda* in this work (p. 17). The same classification is employed in this writer's later works (1806 and 1810); the name is written, however, somewhat differently: *Ostracoda* (pp. 17 and 89), thus with the now generally accepted spelling. In his work of 1829 this author divides „le premier ordre des Entomostracés", *Branchiopoda*, into two branches, *Lophyropa* and *Phyllopa*. *Lophyropa* is divided (p. 151) into three divisions: *Carcinoida*, *Ostracoda* and *Cladocera*. Of these three groups *Ostracoda* includes two genera: *Cythere* and *Cypris*; *Cladocera* consists of three genera *Polyphemus*, *Daphnia* and *Lynceus*. In other words this author thus follows H. E. STRAUS's example in differentiating between *Daphnia* etc. and *Cythere* and *Cypris* but rejects his nomenclature. He writes *Ostrapoda* STRAUS as a synonym for *Ostracoda* LATR., but this is clearly not so. In his work „C o u r s d'E n t o m o l o g i e", 1831, this author is, however, more consistent; in it he employs (p. 429) the name *Ostrapoda* STRAUS for the group formed by the genera *Cythere* and *Cypris*. A. G. DESMAREST (1825) follows H. E. STRAUS consistently. — In passing it may be mentioned that A. PHILIPPI, 1840, p. 186, uses a variant of H. E. STRAUS's term, namely *Ostracopoda*. — T h e n a m e *Ostrapoda* i s o b v i o u s l y t h e r i g h t o n e f o r t h i s g r o u p, but it has been so completely forgotten, the name *Ostracoda* has come into use in such a great number of works and has been so completely admitted into scientific literature that it would be quite impractical at this late date to adopt the older name again, especially as the rules of nomenclature that are now followed do not make it absolutely necessary to use the principle of priority in this case. Accordingly i n t h e p r e s e n t t r e a t i s e I h a v e r e t a i n e d t h e n a m e *Ostracoda*, and I must take the risk of doing the inventor of the name *Ostrapoda* what T. R. R. STEBBING in his work published in 1910 — in which the name *Ostrapoda* is again used — calls on p. 495 „a great injustice".

From the middle of the 19th century the investigation of O s t r a c o d s may be said to begin a new epoch. This is especially the case with regard to the study of the salt-water representatives, i. e. that part of this group to which the present work is devoted.

In the following portion of this historical résumé attention will be paid practically exclusively to progress in the study of the salt-water O s t r a c o d s.

While up to 1840 practically all investigations were concerned exclusively with fresh-water forms and only a few investigators such as O. F. MÜLLER, G. de RIVILLE, H. MILNE-EDWARDS and A. PHILIPPI, the three latter only cursorily, were directly occupied with the study of salt-water forms, towards the middle of the 19th century there appeared a number of scientists with comprehensive and illuminating works on the sea-O s t r a c o d s, and after interest was once seriously roused, investigation has continually been directed to them, even though it must be said that this study, compared with the very intensive work on many other animal groups during the same time, has always been rather badly treated.

Of the very numerous works on the marine Ostracods that have appeared since the beginning of this period only a few of the most important can be mentioned here: W. BAIRD, 1850a, J. D. DANA, 1852, W. LILJEBORG, 1853, G. O. SARS, 1865 and 1887, G. S. BRADY, 1868 b, 1880, F. MÜLLER, 1870, C. CLAUS, 1873, 1874b, 1876 and 1891a, F. DAHL, 1888, G. S. BRADY and A. M. NORMAN, 1889 and 1896, G. W. MÜLLER, 1890, 1894, 1906a and b, 1908, and 1912, and N. HIRSCHMANN, 1912.

The works from the earlier part of this period are for the most part purely classificatory. Questions of oecology and comparative morphology seem as a rule to have been outside the sphere of interest of the authors of this time, or were at least only cursorily discussed. These works are certainly not noteworthy for any great acuteness and preciseness in establishing details of morphology, on the contrary the species described during this time are treated so superficially, the diagnoses often consist merely of generally formulated descriptions of the shell, that in most cases it is quite impossible to identify them with certainty nowadays. Our knowledge of the Ostracod system was, however, rather rapidly enlarged, the main features of the natural classification of this group were already during this period brought within the limits of our knowledge.

Among the earlier works of this epoch one may without hesitation point out that of W. LILJEBORG, published in 1853: „De Crustaceis ex ordinibus tribus: *Cladocera*, *Ostracoda* et *Copepoda*, in Scania occurrentibus" as the foremost, both as regards the excellence of the drawings and the number and exactitude of the morphological details given. On the other hand this work is not distinguished by any systematic acuteness: a striking weakness is shown, for instance, in the complete absence of any classification into families; the Ostracods are in this work divided directly into genera; in the morphological interpretation of some organs of the Cypridinids this author was also not so fortunate. In these two respects this work is far inferior to J. D. DANA's work 1852. With regard to the forms belonging to the group *Cypriformes* W. LILJEBORG attained much better results; these may be said to be a very great advance; unfortunately, however, they could not be used to any great extent because most of the work was written in Swedish.

G. O. SARS' two above-mentioned works, F. MÜLLER's essay on the genus *Cypridina*, 1870, and C. CLAUS' different works all show a fairly big advance in the department of morphological study. G. W. MÜLLER is, however, beyond all comparison the most important author for the development of this study. His monumental monograph „Die Ostracoden des Golfes von Neapel", 1894, dealing with the marine Ostracods in an exceedingly comprehensive and exhaustive way both from the systematical, phylogenetical, morphological, and oecological standpoints, immediately made this group one of the best known among the marine invertebrates.

After this work of G. W. MÜLLER the study of the marine Ostracods may be said to have entered on a barren period. The succeeding works — even those of G. W. MÜLLER himself — are practically all mere descriptions of species. There are, however, a few exceptions, for instance N. HIRSCHMANN's meritorious little work in 1912, especially valuable for the

thoroughgoing study of the organs of copulation in the *Cytheridae*, one of the most difficult problems presented by this group of animals.

For more detailed information with regard to the progress of the study of the Ostracods' special classification, morphology, etc. I may refer the reader to the historical résumés to be found in the succeeding part of this work in connection with the discussion of the various units of the system.

During this period the fundamental features of the natural system of the Ostracods underwent the following development: *Natural system.*

W. BAIRD was the first to divide this group into families. In his above-mentioned work 1850a, „Natural History of the British Entomostraca“ a rather eminent work for its time, this author divides the Ostracod group into three families*:

Family	I. *Cypridae*	with the genera	*Cypris* and *Candona*.
,,	II. *Cytheridae*	,, ,, ,,	*Cythere* and *Cythereis*.
,,	III. *Cypridinadae*	,, ,, genus	*Cypridina*.

The families are classified by this author directly into genera.

J. D. DANA makes a further very important advance. In his monumental work on the *Crustacea* brought home by the „United States Exploring Expedition“ of 1852, he divides the Ostracods, called *Cypridacea* or *Cyproidea*, into two families, both composed of two sub-families:

Family	I. *Cypridae*,	comprising the sub-families	*Cyprinae* and *Cytherinae*.
,,	II. *Halocypridae*,	,, ,, ,,	*Cypridininae* and *Halocyprinae*.

The last-named sub-family comprises the two interesting genera discovered by this author, *Halocypris* and *Conchoecia*. The sub-families are divided in this work directly into genera and species. This classification may be said to form the basis of the present system of the Ostracods.

The classification employed by G. O. SARS in his work on the Ostracods of Norway, 1865, certainly follows that worked out by J. D. DANA, but is, however, noteworthy partly on account of the far-reaching extention of the new groups by the establishment of a rather large number of new genera, partly by the founding of some new main groups, based on forms that were completely or almost completely unknown to former authors, partly too because in this work the names nowadays adopted for the large main groups were used for the first time. G. O. SARS divides the Ostracods into four sections, comprising altogether six families:

Sectio	I. *Podocopa*	comprising the families	*Cypridae* and *Cytheridae*
,,	II. *Myodocopa*,	,, ,, ,,	*Cypridinadae* and *Conchoeciadae*
,,	III. *Cladocopa*,	,, ,, family	*Polycopidae*
,,	IV. *Platycopa*,	,, ,, ,,	*Cytherellidae*.

* In a scheme on p. 14 of the same work, in which W. BAIRD says that he wishes to „give a complete view of the arrangement of the British *Entomostraca* which I propose to adopt“ this author, curiously enough, makes the Ostracods comprise only one family, named *Cypridadae*, including all the five above-mentioned genera. The last-mentioned division is also found in this author's work of 1850c.

The sectio *Cladocopa* included a genus *Polycope* that was quite unknown before; the sectio *Platycopa* was based on a genus *Cytherella*, previously known only incompletely from fossil specimens. The families were divided by this author directly into genera and species.

G. S. BRADY in his work 1868 b adopts the above-mentioned classification of SARS's; his work is noteworthy because of the establishment of a new family, *Entomoconchidae*, comprising two genera, *Entomoconchus* and *Heterodesmus*. The question of the value of this family I shall not discuss; I only wish to point out here that the genus *Heterodesmus*, which is placed by G. W. MÜLLER, 1912, among „Ostracodum genera et species incertae sedis", may possibly be regarded as a typical Cypridinid genus; cf. the note below on the sub-genus *Siphonostra*. *Entomoconchus* is only known from fossil specimens.

G. O. SARS carried out a rather important improvement of his above-mentioned system in his work on the Ostracods of the Mediterranean, 1887; in it he arranged the genera *Nesidea* and *Bythocypris* as a separate family within the group *Podocopa*.

Another important thing was the establishment of the family *Darwinulidae* as a new unit within *Podocopa* (G. S. BRADY and A. M. NORMAN, 1889).

Most of the investigators who have worked on this group have adopted unaltered the fundamental principles for the Ostracod classification used by G. O. SARS. G. W. MÜLLER, however, adopted this system only in a modified form. In his large monograph, 1894, this author classifies the Ostracods in the following way:

Tribus I. *Myodocopa*, comprising the families *Cypridinidae*, *Halocypridae* and *Polycopidae*.
,, II. *Podocopa*, ,, ,, ,, *Cypridae*, *Nesideidae*, *Cytheridae*, *Cytherellidae*, and *Darwinulidae*.

In other words, of G. O. SARS' four sections G. W. MÜLLER unites *Cladocopa* with *Myodocopa* and *Platycopa* with *Podocopa*.

Only one author, C. CLAUS, entirely rejects the basis given by J. D. DANA for the Ostracod system. He looks upon the Cypridinids, Halocyprids, Cyprids and Cytherids as equivalent families. See C. CLAUS, 1876, p. 97 and 1891a, p. 6.

G. S. BRADY and A. M. NORMAN, 1896, who, like G. O. SARS, look upon the Polycopids and the Cytherellids as groups systematically equivalent to *Myodocopa* and *Podocopa*, classify *Myodocopa* in no less than five families:

Family I. *Asteropidae*
,, II. *Cypridinidae*
,, III. *Rutidermatidae*
,, IV. *Sarsiellidae*
,, V. *Halocypridae**.

In other words these authors do not, like G. W. MÜLLER, look upon the Halocyprids as a group systematically equivalent to the Polycopids and the Cypridinids, but as

* This is the name that is used for this family on p. 682; in the beginning of the same work, however, these investigators use the name *Conchoecidae*, see pp. 622 and 625, or *Conchoeciadae*, pp. 627 and 628.

equivalent to the sub-groups of the Cypridinids. A. SCOTT, 1905, and A. M. NORMAN, 1905, also employ the same classification.

G. W. MÜLLER, however, even in his later works, among others that of 1912, which to some extent may be said to form a conclusion to an epoch of the history of Ostracod investigation, uses unaltered the fundamental classification that he worked out in 1894. In this he is only followed by T. R. R. STEBBING, 1910.

Since then the system has been enlarged by a number of families being divided into a greater or less number of sub-families. For this development I must refer the reader to the historical résumés given under the sub-orders.

Description of the species.

At a very early date it was surmised that the Ostracods would prove to be one of the groups richest in species within the *Entomostraca* and time has not disproved this. Thus G. W. MÜLLER in his synoptic work 1912 records no less than 1719 described recent species. To judge, however, from the latest works and from my own experiences in working out the present treatise, this figure seems by no means to be the limit. At the present time there seems to be on the earth an Ostracod kingdom enormously rich in forms. Under these circumstances it is, of course, absolutely necessary to take the utmost care in introducing new forms into the literature, otherwise this will soon be quite unwieldy. This seems, however, not to have been recognised by most of the investigators who have been occupied with the systematization of the Ostracods. This may perhaps best be illustrated by G. W. MÜLLER's statement (1912) that only 921 out of the 1719 species recorded by him could be considered as „certain"; in reality the proportion between „certain" and „uncertain" species is probably even more discouraging. This lack of care applies especially to the works of G. S. BRADY, one of the most productive authors in this departement. It must be admitted that most, almost all, the descriptions of species that this industrious author has published are so incomplete and uncertain that they are quite insufficient for full certainty of identification. Instead of advancing our knowledge of the Ostracods most of this author's work has only rendered the study of this group of animals more difficult. But even the most eminent of our Ostracod investigators — G. W. MÜLLER not excepted, this applies especially to some of this author's later works — can scarcely be acquitted of the charge of superficial descriptions. One must admit, unfortunately, that the method of description of species within this group is still at rather a low level.

Various systems.

Remarks: — As appears from the preceding historical survey, there are, with regard to the main lines for the systematic classification of the Ostracod group, three separate and mutually opposed views present in the literature of the subject, namely those of G. O. SARS, G. W. MÜLLER and C. CLAUS.

According to G. O. SARS this group is to be divided in the following way:

Sectio I. *Podocopa*, comprising the families *Cypridae*, *Darwinulidae*, *Nesideidae*, and *Cytheridae*
„ II. *Myodocopa*, „ „ „ *Cypridinidae* and *Halocypridae*
„ III. *Cladocopa*, „ „ family *Polycopidae*
„ IV. *Platycopa* „ „ „ *Cytherellidae*.

According to G. W. MÜLLER's view, the following is the correct classification:

Tribus I. *Myodocopa*, comprising the families *Cypridinidae*, *Halocypridae*, and *Polycopidae*
,, II. *Podocopa*, ,, ,, ,, *Cypridae*, *Darwinulidae*, *Nesideidae*, *Cytheridae*, and *Cytherellidae*.

C. CLAUS, on the other hand, divides the Ostracod group directly into families. According to this author the Halocyprids form a transitional group between the Cypridinids and the families grouped under *Podocopa*.

Which of these methods of classification is preferable? Is any of them to be regarded as completely right?

I have tried to answer these questions in the second chapter of the general part of this work, entitled: „Contributions to our knowledge of the natural system of the Ostracods." As is seen in p. 101 the result of my study has been to show that it does not seem quite convenient to adopt any of these three methods of classification quite unaltered. It appeared to me to be necessary to divide G. O. SARS' sectio *Myodocopa* into two main groups equivalent to *Podocopa*, *Cladocopa* and *Platycopa*, but apart from this SARS's view has been accepted. The main classification of the Ostracod group that is employed in this work is as follows:

Sub-order I. *Cypridiniformes*, comprising all Cypridinids
,, ,, II. *Halocypriformes*, ,, ,, Halocyprids
,, ,, III. *Polycopiformes*, ,, ,, Polycopids
,, ,, IV. *Cypriformes*, ,, ,, Cyprids, Darwinulids, Nesideids, and Cytherids
,, ,, V. *Cytherelliformes*, ,, ,, Cytherellids.

In what order ought these groups to be placed? In other words, is it possible to decide which groups are most primitive?

As is shown in the above-mentioned chapter in the general part of this work, the facts of the matter are presumably that each group is in a number of respects more primitive than the others, in other respects more developed. It is difficult to decide with certainty which of these groups has the greatest number of primitive characteristics. Under these circumstances it seems to me most convenient to adopt the arrangement used by G. W. MÜLLER.

Sub-Order I. Cypridiniformes.

Gen. „C y p r i d i n e s", H. MILNE EDWARDS, 1838, p. 178.
„ *Cypridina*, H. MILNE EDWARDS, 1840, p. 409.
Fam. *Cypridinadae*, W. BAIRD, 1850 a, p. 176.
Sub-Fam. *Cypridininae*, J. D. DANA, 1852, p. 1281.
Fam. *Cypridinidae*, G. S. BRADY, 1868 b, p. 462.
„ „ G. W. MÜLLER, 1894, p. 203.
„ *Asteropidae* + Fam. *Cypridinidae* + Fam. *Rutidermatidae* + Fam. *Sarsiellidae*, G. S. BRADY and A. M. NORMAN, 1896, pp. 628, 638, 673, 675.
„ *Cypridinidae*, G. W. MÜLLER, 1912, p. 7.

Diagnosis: — S h e l l: — Has most often on the anterior border a more or less well-developed rostral sinus, placed at or a little beneath, rarely a little above, half the height of the shell; its dorsal and ventral margins most often more or less convex; the hinge very seldom with teeth; within the free edge of the shell a greater or less number of medial bristles*; the edges of the valves without or with comparatively few glands; most often with a strong incrustation of lime.

F i r s t a n t e n n a: — Originates rather deep down on the front. Strong, more or less elongated, with 5—8 joints; first joint quite without bristles, is directed more or less upwards, and together with the next joint forms a decided knee, open downwards. The original fifth joint has, in the male always, in the females most often, distally at the back a powerful sensory bristle, always (?) furnished with sensory filaments, termed „the sensory bristle of the fifth joint", but apart from this this joint has no bristles at all. This limb is principally a sensory and locomotory organ, as an organ of locomotion, however, it never co-operates in swimming.

S e c o n d a n t e n n a: — The p r o t o p o d i t e is situated on the side of the upper lip. With a rather narrow base, very movably united to the body; large, relatively high, heart- or pear-shaped flattened at the sides, with very powerful musculation, unjointed, without any obvious traces of the boundary between the original joints; sometimes with a short bristle

* These medial bristles prevent foreign particles from entering the cavity of the shell but allow a free exit, being, at least the outer ones, almost always directed outwards.

situated distally. E x o p o d i t e: Very movably joined to the protopodite, with which, in a position of rest, it forms a decided, ventrally open knee; developed into a powerful, long, cylindrical, (always?) 9-jointed locomotive organ (in all the species of this group investigated by me for this treatise I constantly found nine joints); almost always used for swimming. Its first joint always extended, forming distally-laterally a powerful, almost rectangular process which extends over the base of the second joint (functions as a ratchet), is either entirely without bristles or has distally-ventrally an extremely short and weak one. The succeeding joints grow narrower the more distally they are situated; the distal one is very small; at least the six distal ones of them are short; the second to the eighth joints each have a bristle distally-ventrally and somewhat medially; on the third to eighth joints these bristles are long and powerful, annulated along the greater part of their length; most of them most frequently provided with natatory hairs arranged in feather shape; the bristle of the second joint generally rather long, powerful, annulated, in exceptional cases almost completely reduced; the end joint has distally more than one bristle, one of which at least is long and powerful. A greater or less number of the distal joints have a more or less powerful spine situated ventrally-distally and somewhat laterally. E n d o p o d i t e: Always considerably shorter and weaker than the exopodite; of a rather varying type, with never more than three joints; sometimes more or less reduced in one or both sexes. In the male often developed into a clasping organ by which the female is held fast; never used as a locomotory organ.

M a n d i b l e: — This is always very powerful, and elongated, chiefly used for crawling and digging. P r o t o p o d i t e: This is always two-jointed. The coxale, which is fixed at the sides of the body just behind the second antenna, has most often a comparatively weak endite directed backwards-dorsally (used only for inserting the food into the oesophagus, never as a masticatory organ?); this endite is sometimes, however, entirely absent. An endite is sometimes found on the basale in the A s t e r o p i d s, but there is usually no well-developed one; traces of an endite in the form of an accumulation of bristles proximally-ventrally-medially on this joint can most often, however, be stated to exist. E p i p o d i a l a p p e n d a g e always absent. E x o p o d i t e: Is fixed distally-dorsally-laterally on the basale, always more or less diminutive (reduced?), unjointed, often including the openings of a powerful gland; sometimes entirely absent. E n d o p o d i t e: Is always powerful, 2—3-jointed, forming together with the protopodite a decided knee open downwards.

M a x i l l a: — Very varying in type; always used in taking up food. With a well-developed e n d o p o d i t e. Its e x o p o d i t e always more or less reduced, sometimes even quite absent. E p i p o d i t e sometimes developed, forming a lamelliform appendage, most often with fine hairs and quite without bristles.

F i f t h l i m b: — Similarly of very various types, always used in taking up food. Fixed at the sides of the body, just at the boundary between the head and the body. Always with a relatively short e x o p o d i t e. E n d o p o d i t e often not developed. With a large and powerful oval e p i p o d i a l a p p e n d a g e developed as a vibratory plate, attached vertically to the protopodite along its whole length and furnished with very numerous marginal bristles, not divided into distinct groups; these bristles are furnished along

the greater part of their length with close, fine, stiff, rather long hairs, arranged in shape of feathers.

Sixth limb: — Forms a comparatively short, lamelliform, very slightly moveable or sometimes immoveable, plate of somewhat varying type, situated ventrally on the body between the mouth and the furca; is apparently never used as a locomotory organ.

Seventh limb: — Originates rather high up on the side of the back of the body. Very elongated and mobile, annelid-like, with very numerous joint-like, ring-shaped chitinous stripes (like the structure of the trachea), but with no real division into joints; flattened distally and here armed more or less abundantly with cleaning bristles arranged in a single row along the dorsal and ventral edges of the limb. The cleaning bristles are of about the same type within the whole group, rather powerful, annulated and provided distally with bell-shaped segments, overlapping each other somewhat; these segments become more and more narrow the more distally they are situated, and are armed along the distal edge with a dense series of moderately long, fine, stiff spines. This limb is often fitted at its point with teeth arranged in the shape of a comb. It is absent in males of the genus *Sarsiella*.

Brush-like organ: — Is absent almost throughout. For the possible occurrence of this organ on the penis see p. 76 above.

Copulatory organ: — Paired, varies a good deal in type; compared with the same organ in other Ostracod groups it is in most cases of a rather simple structure. The vasa deferentia do not pass through it.

Furca: — Always well developed, large, powerful, with comparatively short, broad lamelliform rami, always armed with several powerful claws. The posterior part of the dorsum forms a rather strongly chitinized, oval, somewhat spoon-shaped furcal field, which is well defined from the furcal lamellae and furnished with a well developed muscular system: see G. W. MÜLLER, 1894; pl. XXXV, figs. 5 and 11. Proximally to the furcal claws there is no unpaired bristle (such as is found for instance in Halocyprids and Polycopids).

Alimentary organs: — Mouth wide, narrowing rapidly towards the interior. Atrium relatively weakly defined. Labrum varying in type, sometimes very large, sometimes rather small. Lower lip very small, may be quite absent. Paragnates most frequently quite absent, and if developed, small and weak. The glands of the upper lip most frequently developed but very varying in type and development; may be absent. Oesophagus rather long, most frequently very strongly muscular, somewhat varying in type. Stomach large, oval, most frequently without hepatical appendages; surrounded by a layer of pigment cells, outside which is to be found a stratum of wide-meshed connective tissue. Rectum very short, opening out in front of the furca. No parts of the digestive organs ever penetrate between the lamellae of the shell.

Sexual organs: — Male: The testes are paired and consist of two bag-shaped oval bodies situated posteriorly in the body. From each of the testes there runs a rather short, wide canal, vas deferens; the vasa deferentia emerge with a common pore just in front of the anus, i. e. between the two penes; they unite rather near the outer exit: see G. W. MÜLLER, 1894, pl. XXXVIII, fig. 30. Female: The ovaries, like the testes,

are paired and are situated posteriorly in the body. In young specimens they are bag-shaped, in mature specimens shaped like a bunch of grapes; see G. W. MÜLLER, 1894, pl. XL, fig. 27. They gradually pass into the thin-walled oviducts (which are widened distally only in exceptional cases); these emerge paired, in most cases on small genital lobes situated in the corresponding places as the copulatory organs of the male. Two receptacula seminis are developed, one on each side; each receptaculum consists of a chitinous capsule, which is sometimes sunk deeply in the body, but in most cases, however, projects freely (in the genital lobe) and emerges close to the oviduct. No parts of the genital organs penetrate between the lamellae of the shell.

Heart always developed.

Organs of sense: Lateral eyes most frequently well-developed, less often more or less reduced, seldom quite absent; the number of ommatidia varying greatly. — The nauplius or median eye situated rather deep down on the forehead, always developed, sometimes (*Gigantocypris*) extremely large. Ventrally close to the nauplius eye there is a rod-shaped frontal organ, often rather long, sometimes very small (or even not developed at all?). — Some of the limbs have sensorial bristles.

Branchiae sometimes developed dorsally on the back of the body.

The eggs are carried continuously after laying between the shell and the back of the body until they hatch.

Salt-water forms of moderate size or sometimes even very large (maximum length so far found: 21 mm., *Gigantocypris*). Most frequently more or less completely confined to the bottom; sometimes, however, they belong entirely to the plankton.

Special terminology: — Second antenna: — The spine at the base of the natatory bristles of the exopodite is called „basal spine".

Mandible: — It does not seem to be quite right to follow most writers in calling the endite of the coxale a „masticatory process" since, at any rate as far as we know, it is not used directly in dissecting food. In the present work it is called (except in the family *Asteropidae*) simply endite.

Seventh limb: — The bell-shaped segments distally on the cleaning bristles are called „bells"; the most distal of these segments often „the end-tongue". The comb-like formations distally on this limb are called „end-combs".

*Historical**: — Some of the first publications about forms belonging to this group consist merely of descriptions of species written in very general terms, based exclusively on the outer characteristics of the shell. But even the earliest writers on this subject made an attempt at

* On account of profound differences between the Asteropids and the other forms belonging to the group discussed here both in their morphology and oecology, the knowledge of the first-named group has developed in a rather independent manner. Because of this it seemed most convenient to me in the present treatise to discuss the history of the investigation of the Asteropids in a special chapter together with other problems concerning this group.

a closer study of the morphology of these animals and the main features of this became rather well known comparatively soon.

At first rather serious mistakes were made in interpreting the limbs, the organs which, after the shell, quite naturally aroused the greatest attention; this is, of course not so surprising when one remembers the frequently peculiar type of these organs, how closely together they are situated and the small size of the forms investigated. *The interpretation of the limbs.*

Thus H. MILNE EDWARDS in his work of 1840 denotes these organs as follows: „antenne supérieure pediforme" (= first antenna), „patte natatoire" (= second antenna), „antenne inférieure" (= mandible), „mandibule" (this organ is interpreted by C. CLAUS, 1873, p. 214 as „einen paarigen Seitenfortsatz der Oberlippe"; it seems to me impossible to decide with certainty whether this assumption is correct or whether the organ described by MILNE EDWARDS may possibly be the maxilla), „machoîre de la première paire" (= fifth limb), „machoîre de la deuxième paire" (presumably the sixth limb; it seems to me rather improbable that it should be the maxilla; if it were so the sixth limb, which is rather conspicuous, would not have been observed at all) and „patte ovifère" (= seventh limb). The descriptions and drawings of these organs are extremely incomplete and uncertain. This author writes on p. 410: „Les deux paires d'antennes . . . . constituent des rames natatoires . . ." — In W. BAIRD's work of 1847 we find the following interpretation: „anterior antenna" (= the mandible), „natatory foot" (= the second antenna), „second pair of antennae" (= the maxilla), „the mandible I did not succeed in seeing", „first pair of jaws" (= the fifth limb), the sixth limb is not mentioned, the „oviferous foot" (= the seventh limb). Compared with this interpretation the one we find in the same author's work of 1850 a may be considered as an advance, even though a small one: „first pair of antennae" (= first antenna), „second pair of antennae" (= mandible), „natatory foot" (= second antenna), „the mandible is a flat plate armed at its extremity with three or four sharp teeth", p. 177, (it is difficult to decide which limb or part of a limb is referred to; it may possibly be a part of the fifth limb), „the first pair of jaws is composed of a large body with three or four appendages, like fingers, armed with stout cilia, and having attached to each a large branchial plate", p. 177 (here too it is difficult to decide which parts are referred to, possibly the sixth limb with the vibratory plate of the fifth; it seems improbable that it should be merely parts of the fifth limb that are referred to, one reason among others being that it is certainly a species belonging to the genus *Philomedes* that has formed the basis for these statements), „second pair of jaws" (= maxilla), and „oviferous foot" (seventh limb) — S. FISCHER may be said to have been still more unfortunate in his work of 1855: „erste Antenne" (= first antenna), „zweite Antenne" (= mandible), „Mandibel" (= the fifth limb or the masticatory part of the fifth limb + the sixth limb), „Maxille" (= maxilla), „hinter ihm" (maxilla) „liegt die ziemlich große und starke Kieme" (either the vibratory plate of the fifth limb or the sixth limb) „und unmittelbar unter derselben zwei nach rückwärts gerichtete, mit starken befiederten Borsten versehene Palpen" (= the seventh limb?). This writer is especially unfortunate in the interpretation of the second antenna; the exopodite of this limb is interpreted as the „erste Fuß", its endopodite as „zweiter Fuß". FISCHER also surpasses the two first-named writers in the incompleteness and uncertainty of the descriptions

and reproductions of the limbs. W. LILJEBORG, 1853, who in the interpretation of the limbs of these forms takes the same standpoint as H. MILNE EDWARDS, except that he interprets the maxilla correctly — this pair of appendages is called the first pair of maxillae, the fifth and sixth pairs of limbs the second and third pairs of maxillae — is a good deal superior to his contemporaries in accuracy and acuteness in observing details and in the clearness of his descriptions as well as in the elegance of his drawings. — It may be pointed out as a curious fact that O. COSTA in 1845 explained the exopodite of the second antennae as branchiae, an assumption that was decidedly rejected by E. GRUBE already in his work of 1859, p. 326.

As early as 1852, thus before the above-mentioned works of S. FISCHER and W. LILJEBORG, J. D. DANA, however, gave the first correct interpretation of the limbs of this group, and his view soon found general acceptance*.

With regard to the differences in opinion that have appeared in literature as to the terms for the various limbs and with regard to the various opinions that have been put forward as to the interpretation of the different parts of the limbs I merely refer in this connection to what has been stated above in the chapter on terminology and the morphology of the limbs.

In 1838 H. MILNE EDWARDS verified the existence of the lateral eyes and correctly described the structure of the furca. In a work of 1840 the same author found that the mouth was provided with an upper lip. W. LILJEBORG finds (1853) the median eye and the rod-shaped organ** and surmises that the latter is a sensory organ; he writes about this l. c. p. 175: „Midt emellan ögonen sitter en lång, utåt afsmalnande papill, som framskjuter mellan de öfre antennerna. Vid basen är den uppsvälld, med en uppstående utvidgning, som innesluter ett ämne, som mycket liknar ögats pigment. Möjligen torde denna papill vara ett känsel-organ"***. This discovery seems to have been quite overlooked by most of the succeeding writers. In 1864 F. MÜLLER stated (p. 72) that *Cypridina*, contrary to *Cypris* and *Cythere*, had a heart. — In passing it may be pointed out that G. W. MÜLLER, 1894, p. 169 writes that C. CLAUS was the first to observe this organ. It is certainly true that in his work of 1865, p. 143, C. CLAUS says that he had discovered this organ quite independently of other investigators, but when he published the work in question he had already (cf. p. 145) seen the above-mentioned publication of F. MÜLLER.

The year after this work by F. MÜLLER there appeared almost simultaneously two very important treatises, first C. CLAUS's „Ueber die Organisation der Cypridinen" and shortly afterwards G. O. SARS's „Oversigt af Norges marine Ostracoder". In both these works clear and also rather detailed descriptions were given of both the exterior and interior morphology of these animals, which may be said to have become fairly well known through these works.

* On pl. [illegible] the work mentioned the fifth and sixth limbs are placed by mistake in the wrong order.

** The rod-shaped organ in the Halocyprids was discovered one year earlier by J. D. DANA.

*** Translation: Between the eyes there is a long papilla growing narrower distally, which projects between the upper antennae. It is smaller at its base and has here an upward directed hump containing a material that is very like the pigment of the eye. This papilla may possibly be a tactile organ."

By his work „Ostracoda mediterranea“, 1887, G. O. SARS also helped in a high degree to make this group of animals known. This work together with G. W. MÜLLER's big monograph of 1894 — especially the latter — are the publications that, broadly speaking, may be said to have carried our knowledge of the forms belonging to this sub-order to its present standpoint. Not only did the latter work, with its multitude of details, fill many gaps in our knowledge of the morphology of these animals, but in it, generally speaking, they were treated, for the first and only time, from standpoints other than a purely morphological-classificatory one; even their oecology was the subject of a rather thorough study.

Of the other publications that deal with this group we may only mention here: A. GARBINI, 1887, in which *Cypridina mediterranea* O. COSTA was submitted to a morphological-histological investigation; the following organs were dealt with: the first antenna, alimentary organs, central nerve system, sensory and sexual organs. It is quite a meritorious work. C. CLAUS (1891 b) dealt with the median eye, A. RAMSCH (1906) the female sexual organs in *Cypridina;* L. LÜDERS (1909) made a rather thorough study of the organisation of *Gigantocypris.*

Natural system.

The first to give a scientific name to and describe a species belonging to the sub-order *Cypridiniformes* was H. MILNE EDWARDS in his treatises of 1838 and 1840. As is seen from the historical summary given above this author distinguished the new form from the other then known recent Ostracods — divided into two genera, *Cypris* and *Cythere* — by taking it as a representative af a new genus, *Cypridina.* W. BAIRD, 1850a, separated the then known forms of this group as a special family *Cypridinadae*, by the side of which he put the families *Cytheridae* and *Cypridae.* C. CLAUS suggested, 1876 (p. 94, note 1)), that the genus *Asterope* should be distinguished as a special family „der Asteropiden“ from other genera of this group then known, namely *Cypridina*, *Monopia* and *Philomedes.* G. S. BRADY and A. M. NORMAN, 1896, divided the known forms of this group into four families:

Family I. *Asteropidae*	with only one genus	*Asterope*
„ II. *Cypridinidae*	„ six genera	*Crossophorus* *Cypridina* *Philomedes* *Streptoleberis* *Tetragonodon* *Paramekodon*
Family III. *Rutidermatidae*	„ only one genus	*Rutiderma*
„ IV. *Sarsiellidae*	„ three genera	*Eurypylus* *Sarsiella* *Nematohamma.*

G. W. MÜLLER in his later works (1906 b, 1912) employs the following division of this group:

Sub-family I. *Cypridininae*	with five genera	*Cypridina* *Pyrocypris* *Crossophorus* *Codonocera* *Gigantocypris*

Sub-family II. *Philomedinae*	..	three genera	*Philomedes* *Pseudophilomedes* *Rutiderma*
.. III. *Sarsiellinae*	..	one genus	*Sarsiella*
.. IV. *Asteropinae*	..	two genera	*Asterope* *Cyclasterope*.

Of these genera G. W. MÜLLER writes:

Philomedes	as a synonym of	*Tetragonodon*
Pseudophilomedes	.. ..	*Paramekodon*
Sarsiella	.. ..	*Streptoleberis* *Eurypylus* *Nematohamma*

In his synoptic work in „Das Tierreich", 1912, this author records 155 recent species of this sub-order, 105 of which would be „certain", 50 „uncertain". The proportion between „certain" and „uncertain" is, however, much more in favour of the latter category, a fact that I have unfortunately been only too often reminded of during my study of this group. After this work of G. W. MÜLLER some additional species, though only a few, have been incorporated in the literature of this group.

Remarks: — The difference between the two above-mentioned divisions of this sub-order worked out by G. S. BRADY—A. M. NORMAN and G. W. MÜLLER is, as is seen at the first glance, not profound. Two divergencies are to be noted. First G. W. MÜLLER has removed the genera *Philomedes* and *Pseudophilomedes* from G. S. BRADY's and A. M. NORMAN's family *Cypridinidae* and of these has formed a new systematic unit, the sub-family *Philomedinae*, ranged with the sub-family *Cypridininae*, which includes all the remaining genera of the above-named family, and with the sub-families *Sarsiellinae* and *Asteropinae*. Secondly the same author has adopted the genus *Rutiderma* in the new sub-family *Philomedinae*, which genus had formerly been distinguished by G. S. BRADY and A. M. NORMAN as a representative of a special family *Rutidermatidae*, ranged with the Cypridinids, Sarsiellids and Asteropids.

Which of these divisions is preferable? Is any of them quite natural or is none at all suitable to be accepted without alteration?

A thorough study of the forms belonging here has led me to the following conclusions:

The separation attempted by G. W. MÜLLER of the genera *Philomedes* and *Pseudophilomedes* from the genera *Cypridina*, *Pyrocypris*, *Crossophorus*, *Codonocera* and *Gigantocypris* is undoubtedly at least partly justified. The two first-mentioned genera are, as is clearly shown by the descriptions given by G. W. MÜLLER and by those I have worked out below, decidedly opposed to the genera enumerated after them in so many respects that they must necessarily be separated systematically from the latter.

This, however, does not prevent the division given by G. S. BRADY and A. M. NORMAN from having its advantages. The sub-families *Cypridininae* and *Philomedinae* are, it is true, well differentiated from each other, but on the other hand they are considerably more closely

related to each other than to the sub-families *Sarsiellinae* and *Asteropinae*; the similarity between the two latter sub-families is, in addition, considerably less than that existing between *Cypridininae* and *Philomedinae*.

With regard to the classificatory position of the genus *Rutiderma* the following information, taken from G. W. MÜLLER's work of 1908, p. 91, may be put forward. (I have unfortunately had no opportunity myself of personally investigating any form belonging to this interesting genus):

> The shell reminds one strongly of the shell of some species belonging to the sub-family *Philomedinae*, but on the other hand it undoubtedly approaches the type of shell in the sub-family *Sarsiellinae*.
>
> The first antenna shows entirely the same structure as that of the females of *Sarsiella*.
>
> Second antenna: The reduction of the endopodite of this antenna reminds one of *Sarsiella*; the bristles on the exopodite of the females of *Philomedes*.
>
> The mandible has a structure that differs greatly from all other Ostracods, but still it shows a certain relationship both to *Philomedes* and to *Sarsiella*.
>
> The maxilla shows a type rather similar to that of the females of *Sarsiella*; it has, on the other hand, no close resemblance to *Philomedes*.
>
> The fifth limb is, on the contrary, considerably more like this appendage in the sub-family *Philomedinae*, it has no close resemblance to this appendage of *Sarsiella*.
>
> The sixth limb is about half way between *Philomedes* and *Sarsiella*.
>
> The remaining organs „scheint bei der Beurteilung der Frage nach den verwandtschaftlichen Beziehungen kaum von Wert".

Finally on the page just mentioned G. W. MÜLLER writes as follows: „Versuchen wir an der Hand des gegebenen Materials die Frage nach der Zugehörigkeit zur einen oder anderen Unterfamilie zu beantworten, so scheint es nicht leicht, diese Antwort zu geben; mit beiden Unterfamilien stimmt sie in Organen überein, deren Bau für die Unterfamilie besonders charakteristisch, mit *Philomedes* im Bau des ersten und zweiten Thoraxbeines, mit *Sarsiella* im Bau der ersten Antn., der Mandibel und der Maxille, doch ist zu bemerken, daß sich die erste Antn. auch nicht allzuweit von der von *Philomedes* ♀ entfernt, und daß die Übereinstimmung mit *Sarsiella* im Bau der Mandibel keineswegs eine vollständige ist. Im ganzen ist unzweifelhaft die Übereinstimmung mit den *Philomedinae* größer, und halte ich es für angebracht, sie dieser Unterfamilie einzureihen. Aber schließlich ist das etwas Geschmackssache, da die verwandtschaftlichen Beziehungen zu beiden Familien unzweifelhaft" . . . .

This result, the grouping of the genus *Rutiderma* with *Philomedes* and *Pseudophilomedes* into one sub-family, seems to me incorrect. For even if *Rutiderma* were to turn out to agree somewhat more closely with the two latter genera than with the sub-family *Sarsiellinae*, it represents, all the same, a rather divergent type. It seems to me, therefore, more convenient to follow the example of G. S. BRADY and A. M. NORMAN and to distinguish this genus as a representative of a higher classificatory unit.

The result of this discussion is consequently that neither of these two divisions is to be accepted unaltered. The following combination of the two has been used by me in the present work:

Family I. *Cypridinidae* { sub-family *Cypridininae*
{ „ „ *Philomedinae*

„ II. *Rutidermatidae*

„ III. *Sarsiellidae*

„ IV. *Asteropidae*.

It is probable, however, that there is not complete equivalence between these four families; yet this seems to me to be the division that best reproduces their mutual relations. In this case it might be said as G. W. MÜLLER wrote about the systematic position of the genus *Rutiderma*: „Aber schließlich ist das etwas Geschmackssache . . . .“

Here it may be pointed out that all the above-mentioned groups, *Cypridininae*, *Philomedinae*, *Rutidermatidae*, *Sarsiellidae* and *Asteropidae* are certainly to be considered quite natural.

Which is the mutual relation of the above-mentioned four families?

It still seems to be too early to try to enter more closely into this problem. For the present I shall therefore confine myself to merely a passing reference to it.

The only writer so far who has dealt with the mutual relationship of the forms belonging to these families is G. W. MÜLLER. In his work of 1890 this author suggested on p. 224 that the genus *Philomedes* would form a connecting link between the genus *Cypridina* s. l. and the genus *Asterope*. The reasons that seemed to this author to support this assumption were as follows:

The shell: In the genera *Philomedes* and *Asterope* there sometimes appears a sculpture of the shell in the form of prominent ridges „die wir nach ihrem gesammten Verlauf als homolog bezeichnen müssen“; such ridges are, on the other hand, not found in *Cypridina*. The selvage is smooth-edged in *Cypridina*, in *Philomedes* it is broken up into hairs at the margin, in *Asterope* it is quite broken up into hairs.

Mandible: The endite on the coxale is small and simple in *Cypridina*, somewhat larger and bifurcated in *Philomedes*, large and very deeply bifurcated in *Asterope*. The endite on the basale is large in *Asterope*, somewhat weaker in *Philomedes*, almost completely or quite completely absent in *Cypridina*.

With regard to the maxilla and the fifth limb the males of *Philomedes* would form a kind of transitional type between *Cypridina* and *Asterope*.

The sixth limb is jointed in *Cypridina* and in this genus the different joints are moved by special muscles, in *Philomedes* this appendage is jointed, the different joints would, however, not be moved by special muscles, in *Asterope* it is quite unjointed.

Seventh limb: In the genus *Cypridina* „sind beide Schenkel der Zange sehr ungleich, bei *Philomedes* sind die Unterschiede geringer, bei *Asterope* sind sie fast ganz geschwunden“.

The rod-shaped organ, like the upper lip, would be alike in *Philomedes* and *Asterope*; the upper lip in these two genera would be specially characterized by the absence of glandular fields.

On the furca there sometimes appear secondary claws, „Nebendornen“ in *Philomedes* and *Asterope*; in the genus *Cypridina* there would be no such claws.

Proceeding from these facts G. W. MÜLLER then put forward the following hypothesis (pp. 225 and 226): „Der auffälligste Charakter der Gattung *Asterope* liegt (abgesehen von den Kiemen) in der Gestaltung der beiden Maxillen; die Formen dieser Gliedmaaßen, welche wir mit den bei *Asterope** vorkommenden glaubten in Verbindung bringen zu können, treten bei *Philomedes* nur als secundäre Geschlechtscharaktere der Männchen auf, als ziemlich auffällige Abweichungen vom Typus. Um diese Formen zur Ableitung von *Asterope* heranziehen zu können, müssen wir zu der Annahme unsere Zuflucht nehmen, daß diese Charaktere des Männchens sich bei einem Zweig der Gattung auch auf die Weibchen übertragen haben, aus welchem Zweig dann die Gattung *Asterope* hervorging. Nehmen wir diese Hypothese an, so bietet sich eine bequeme Handhabe für die morphologische Deutung der beiden Maxillen von *Asterope*, die Kluft, welche *Asterope* von den übrigen C y p r i d i n i d e n zu trennen schien, ist geschwunden (letzteres auch mit Rücksicht auf die Kiemen); nehmen wir sie nicht an, so wird man immerhin nicht leugnen können, daß übrigens eine Reihe von Thatsachen existirt, welche nähere verwandtschaftliche Beziehungen zwischen *Philomedes* und *Asterope* wahrscheinlich machen, was wiederum als Grund für die Richtigkeit der oben geäußerten Hypothese angeführt werden könnte."

In his large monograph of 1894 G. W. MÜLLER deals with this question in only a cursory manner. He merely writes (p. 204): „Ob nun aber *Cylindroleberis*" (= *Asterope*), „wie ich früher annahm, näher mit *Philomedes* verwandt ist, oder nicht vielmehr einen besonderen Zweig darstellt, der sich schon sehr früh von *Philomedes* abgetrennt oder ganz selbständig entwickelt hat, ist schwer zu entscheiden."

In his later works this author does not touch on this problem at all.

Is the genus *Philomedes* to be considered a transitional type between the genera *Cypridina* and *Asterope*, or, perhaps more correctly, is the sub-family *Philomedinae* to be accepted as a connecting link between the sub-family *Cypridininae* and the family *Asteropidae*?

With regard to the characters that G. W. MÜLLER has brought forward as evidence of a closer relationship between *Philomedes* and *Asterope* the following may be pointed out:

The shell: The sculpture of the shell in the Ostracod group is subject to such profound variations and shows so many instances of more or less obvious convergence that this character can certainly not be a suitable one to adduce in this connection. In addition it may be pointed out that most reasons indicate that shells without prominent sculpture, shells with practically a smooth surface represent the primitive stage both in *Philomedinae* and *Asteropidae*. — In the genus *Cyclasterope* the selvage is smooth-edged on the right valve, and partly edged with hairs on the left (see the description of *Cyclasterope fascigera* given below). In addition it does not seem to me impossible that the selvage has originally arisen by fusion of hairs situated in a row. Free selvage bristles *(Asterope)* would in that case denote the most primitive stage, selvage with an edge of hairs, i. e. selvage hairs joined at their bases, *(Philomedes)* the next stage, and selvage with smooth margin *(Cypridina)* the most developed stage. As a support for this assumption it might be mentioned that the selvage is almost always — even when it is quite smooth-edged — cross-striated. Full certainty in this question is, of course, still not to be obtained.

* Obviously a misprint; it should be *Philomedes*.

Mandible: In the sub-family *Cypridininae* there also sometimes appears on the coxale an endite of about the same type as in the females of *Philomedes*, namely in *Crossophorus*.

The maxilla and the fifth limb in the males of the genus *Philomedes* do not form any transitional type to the same organs in the genus *Asterope*; they are, on the contrary, of quite the same type as in the females, with the only difference that most of the parts, especially the masticatory parts, are very much reduced, a reduction that is closely connected with the peculiarity that the males of this genus do not eat food after attaining sexual maturity, but die comparatively soon after fertilization.

Sixth limb: The statement that the different joints of this limb are not moved by special muscles in the genus *Philomedes* is also due to a mistake; at least in all the species of this genus investigated by me this appendage possessed as well-developed a muscular system as the species of the sub-family *Cypridininae* that I have had the opportunity to study personally.

Seventh limb: The distal armament of this limb in *Philomedes* cannot be said to form a transitional type between that of the sub-family *Cypridininae* and that of the family *Asteropidae*; on the contrary it forms an independent type, strongly resembling that of the sub-family *Cypridininae*.

On the furca secondary claws, „Nebendornen", may also appear in the sub-family *Cypridininae*.

The rod-shaped organ cannot apparently be used as evidence either for or against a closer relationship between *Philomedinae* and the Asteropids, as this organ is subject to far too profound variations within the sub-order *Cypridiniformes*. In addition it shows but a rather slight agreement in *Philomedes* and *Asterope*.

The upper lip both in *Philomedes* and *Asterope* has a glandular field, though a small one. The small size of this organ in these two genera may be considered a primitive feature.

The characters that G. W. MÜLLER put forward as evidence for his hypothesis may consequently be divided into three categories:

1) those in which G. W. MÜLLER was mistaken,

2) those which cannot be used as evidence in this problem on account of their great variability, and

3) those which may possibly be suspected of appearing in *Asteropidae* and *Philomedinae* under a comparatively primitive type.

To the first of these categories the following characters would belong: the maxilla, the fifth, sixth, and seventh limbs and the furca. — This author was also mistaken with regard to the selvage of the shell and the glandular field of the upper lip.

To the second category would belong the sculpture of the shell and the rod-shaped organ.

To the third category: the selvage of the shell, the upper lip and the characters taken from the protopodite of the mandible.

It may be impossible at present to prove with full evidence that the characters included in the last category really bear an impression of primitiveness in *Philo-*

medes and *Asterope.* It appears to me that there is a support for this assumption in the following facts:

That the endite on the coxale of the mandible was originally bifurcated in the *Cypridiniformes* seems to be supported by the fact that bifurcation is found not only in the sub-family *Philomedinae* and the Asteropids but also in *Cypridininae* and *Sarsiellidae.* Moreover, in the sub-family *Cypridininae* the bifurcation of this process is best developed in that genus which we have rather good reasons to assume as the most primitive, viz. *Crossophorus*, cf. below, p. 182. In most species of the family *Sarsiellidae* this process seems to be absent, but when it does occur it is deeply bifurcated, at least according to G. S. BRADY and A. M. NORMAN, 1896, Pl. LX, fig. 10. This endite is not developed, so far as is known, in *Rutidermatidae.* — I must not refrain, however, from stating that there are facts that might be considered to point in the opposite direction; cf. below p. 182. — The supposition that the basale of the mandible in *Cypridiniformes* originally had an endite is supported by the fact that an endite on this joint occurs in *Halocypriformes*, *Polycopiformes* and *Asteropidae*, and traces of one in *Philomedinae*, *Cypridininae*, *Sarsiellidae* and *Rutidermatidae*; in the Cyridinenes the traces are best developed in the genus *Crossophorus*, which was pointed out above as being presumably the most primitive type of this sub-family.

The occurrence of glandular fields on the upper lip in both *Cypridininae*, *Philomedinae* and *Asteropidae* seems, of course, to support an assumption of the primitiveness of this character.

With regard to the eventual primitiveness of the selvage of the shell in the Philomedines and Asteropids I content myself with referring to what has been stated above.

Other characters in *Philomedes* could be brought forward, in which this genus agrees more closely with the Asteropids than does the sub-family *Cypridininae.* Among these the following may be mentioned:

The first antenna: The second joint always has a distal-lateral bristle; the posterior edge of the original fifth joint is in the male so much shortened that the sensory bristle of this joint seems most frequently to be placed next to the posterior-distal bristles of the fourth joint. In the males the bristles of the distal joints are always without suctorial organs; the e- and f-bristles (cf. the terminology for the sub-family *Philomedinae*) are very much lengthened in this sex.

The second antenna: The endopodite is always developed as a clasping organ in the males.

The penis is always of about the same type, small with weak musculation, more or less clearly bifurcated distally.

It is, however, to be noted that at least some of these characters may be considered old, presumably belonging to the ancestral forms of *Cypridiniformes.* Such characters are: the absence of suctorial organs on the first antenna in the male, the development of the endopodite of the second antenna as a clasping organ in the male (we find both these characters in the

Cypridinid genus *Crossophorus*, pointed out above as primitive), the slight differentiation and size of the penis and its shape like that of a biramous limb (what is the state of affairs in *Crossophorus* with regard to this is not known).

From what has been stated above it may be clear that there are not adequate reason to justify an assumption that *Philomedinae* is more closely related to the *Asteropidae* than are other forms belonging to the sub-order *Cypridiniformes*. On the other hand, it is, of course, by no means impossible that it is so. It does not seem to me impossible that those of G. W. MÜLLER's characters which were placed in the third category above and at least a few of the characters put forward by me above really indicate a closer relationship between the two first-mentioned groups. The fact that there is a possibility that these characters are more or less primitive causes us, however, to use them only with the greatest caution as evidence in this matter.

The absurdity of G. W. MÜLLER's assumption that the family *Asteropidae* has arisen from *Philomedes*-like forms in which the reduction of the maxilla and fifth limb appeared in both males and females ought in point of fact to be so obvious to every one who knows these forms intimately that a refutation in addition to that which has been given above seems scarcely to be necessary.

Relationship between Cypridina and Asterope.

On the other hand, according to G. W. MÜLLER, loc. cit. p. 224, there were characters to be observed that seem to indicate a closer relation between *Cypridina* and *Asterope*; these characters were:

> The first antenna: In *Philomedes* this has six joints, in *Asterope* and *Cypridina* seven; *Asterope* is, however, strongly differentiated from *Cypridina* by the type of the joints „während in Bezug auf Schlankheit wieder *Philomedes* in der Mitte steht".
>
> Gills, which are characteristic of *Asterope*, occur, although rarely, in *Cypridina* but, on the other hand, are never found in *Philomedes*; this last-mentioned fact loses — according to this author — in importance, however, if we assume that gills were characteristic of the ancestral forms of the sub-ordo *Cypridiniformes*.

It must be clear to every one who has closely studied the last-mentioned group that the number of joints on the first antenna cannot be used to support an assumption that the A s t e r o p i d s approach the sub-family *Cypridininae*. The number of joints is, in reality, not infrequently different in males and females of the same species of these groups. The importance of the gills for the solution of this question may be said to be very small; these simple organs may very well have developed by convergence in *Cypridininae* and *Asteropidae*.

Relationship between Sarsiella and Philomedes.

According to G. W. MÜLLER's statement, 1890, the genus *Sarsiella* also resembles *Philomedes*. The characters brought forward to support this assumption are as follows (p. 226): „In einigen Punkten erinnert sie an die Männchen von *Philomedes*, so

im Fehlen des Kaufortsatzes der Mandibel und

im Bau der zweiten Maxille.

Beachtenswerth erscheint die Reduction der Glieder der ersten Antenne,

das Fehlen jeder Gliederung am Maxillarfuß,

das Auftreten von erhabenen Leisten auf der Oberfläche der Schale."

In his large monograph on the Ostracods (1894) G. W. MÜLLER makes a reservation to this statement (p. 204) in the same way as he does to his statement with regard to the relationship of the genus *Asterope* to *Philomedes* quoted above. He writes: „Aehnlich gilt für *Sarsiella*.“ — After having investigated a species belonging to the genus *Rutiderma*, this author states once more, 1908, pp. 91 and 92, that *Sarsiella* is closely related to *Philomedes*. The genus *Rutiderma* is assumed to be an intermediary form of these two genera. He writes as follows: „Die verwandtschaftlichen Beziehungen denke ich mir so, daß *Rutiderma* von der Reihe, welche von *Philomedes*-ähnlichen Formen zu *Sarsiella* führte, sich abzweigte; sie als ein unverändertes Glied der Ahnenreihe von *Sarsiella* zu betrachten, scheint mir durch den Bau der Mandibel ausgeschlossen.“

Is the genus *Sarsiella* to be considered as relatively closely related to the genus *Philomedes*?

With regard to the characters put forward by G. W. MÜLLER in 1890 to support this assumption the following may be mentioned:

Mandible: The endite on the coxale of this limb is not to be put forward as evidence; the males of the genus *Philomedes* are not (or at least are not always) without this process; besides, a process of this sort is also to be found in some species of *Sarsiella*. cf. G. S. BRADY and A. M. NORMAN, 1896, Pl. LX, fig. 10.

The fifth limb in *Sarsiella* shows no striking resemblance to the same appendage in *Philomedes*, rather the other way about.

With regard to the number of joints on the first antenna, the sixth limb and the sculpture of the shell it is certainly enough to refer to what I have said above, during the discussion of the relations of the genus *Asterope*. In other words these characters cannot be used as evidence for an assumption that *Sarsiella* shows agreement with *Philomedes*.

In short, facts have not yet been brought forward to prove this assumption. We must answer the question in the negative.

Rutiderma a link between Sarsiella and Philomedes?

Whether the genus *Rutiderma* can be considered as a link between *Sarsiella* and *Philomedes* I must leave quite open. In any case it is certain that this genus, as was pointed out by G. W. MÜLLER, is not an unchanged type in the genealogical table of *Sarsiella*.

Result

In my opinion the four families, *Cypridinidae*, *Rutidermatidae*, *Sarsiellidae* and *Asteropidae*, are variations of one and the same type and were separated from each other presumably rather early, afterwards differentiating independently. In some characters a family shows a rather close resemblance to one family, in others to another (partly due to convergencies?); in some characters, on the other hand, it is more or less aberrant.

Family Cypridinidae.

Fam. *Cypridinidae*, G. S. BRADY and A. M. NORMAN, 1896, p. 638.
Sub-Fam. *Cypridininae* + Sub-Fam. *Philomedinae* (part.), G. W. MÜLLER, 1906 b, p. 12.
" " " " " " " " " " 1912, pp. 8, 24.

Description: Shell: — With or without sexual dimorphism. — The rostral incisur is in most forms rather deep, in others, on the contrary, more or less shallow, but is never, however, quite absent; the upper lip of the incisur does not grow over the under one. The selvage varies in type, but is always lamelliform and most frequently well developed both on the rostrum and along the greater part of the ventral margin of the shell; it runs about parallel to and somewhat within the free edge of the valve. The list runs from the rostral incisur in an even, unbroken bow along the ventral and posterior edge of the shell, and finishes at the back near the hinge of the shell (exception among the hitherto known forms: *Siphonostra* and *Cypridinodes*, cf. below, the diagnoses of these sub-genera); it is sometimes narrow throughout its whole length or else somewhat broader at the back; the distance from the list to the edge of the shell is, on the average, somewhat greater along the back edge of the shell than along the ventral edge. The valves, as in all forms belonging to the Ostracods, are joined along less than half the periphery; in only a single one of all the genera so far known, the genus *Gigantocypris* (cf. below, the diagnosis of this genus) are they joined along more than half the periphery of the valves. The males never have a ring of hairs round the posterior part of the shell.

First antenna: — This has more or less strongly marked sexual dimorphism. — The sensory bristle of the fifth joint developed very variously, sometimes entirely absent in the females. The original sixth joint has always only one bristle, placed distally-medially. Distally this limb has seven to eight bristles, three to four of which are probably to be considered as belonging to the original seventh joint and four to the original eighth joint. The anterior bristle on the original seventh joint (a-bristle, cf. below, the terminology for the sub-family *Cypridininae*) is never developed in the shape of a claw.

Second antenna: — In a number of forms this limb is characterized by sexual dimorphism, in others it is almost or entirely without it. — Endopodite: In the female most frequently rather small and weak, sometimes even more or less entirely reduced. In the male this branch is sometimes of the same type as in the female, sometimes it is developed as

a powerful, three-jointed clasping organ. The end joint in the female — and also in the males in which this branch is not developed as a clasping organ — is always furnished with only one bristle; this bristle is fixed at or near the point of the joint, often attains a rather considerable length, is finely annulated, naked and more or less rounded distally (a sensory bristle?). In the males in which this branch is developed as a clasping organ this joint is furnished with a similar bristle, fixed ventrally, near the proximal boundary of the joint (homologous with the bristle in the female?) and most frequently with a few (always two?) short distal bristles, placed close together.

Mandible: — With or without sexual dimorphism. — The protopodite joints, like the two proximal endopodite joints, are always comparatively large and powerful, the end joint of the endopodite is, on the other hand, very small. Protopodite: The endite of the coxale is most frequently (always? cf. below in connection with the description of the males of the genus *Philomedes*) developed in both males and females, small but rather powerfully built, not lamelliform and hyaline, simple or more or less bifurcated distally. Basale: Has no well-developed endite proximally-ventrally-medially but, on the other hand, always or almost always traces of one in the form of a number of bristles. This joint always has two bristles dorso-distally. The exopodite is always developed, always has two most often rather long bristles situated ventero-distally and always the openings of a large gland. The endopodite is three-jointed, its end joint has practically always seven bristles.

Maxilla: — Cf. fig. III, p. 32. With or without sexual dimorphism. — In most cases it is developed as a masticatory organ, short and powerful, with strong musculature. The males of the sub-family *Philomedinae* are exceptions, in them this limb is very weak and certainly not used for mastication of food. It consists of a powerful, thick but rather short protopodite with three joints, a rather large and strong, two-jointed endopodite and a more or less reduced, weak and unjointed exopodite. Between the coxale and the basale this limb forms a ventrally open knee. Protopodite: All the three joints are generally well defined and moveably joined with each other; procoxale and coxale are most frequently rather large, basale is rather small or of moderate size. It is not furnished ventrally with numerous long bristles arranged in a row like the plates of baleen of a baleen whale (as in the family *Asteropidae*). The procoxale and coxale are armed with three, in exceptional cases *(Pseudophilomedes)* with only two, large, powerful masticatory processes, fitted distally with powerful bristles. In the males of the sub-family *Philomedinae* these endites are rather large, but nevertheless extremely weak, cf. above. The masticatory processes are flattened, situated with their flat sides pressed rather closely against one another, overlap each other a little, and are somewhat turned outwards in relation to the longitudinal axis of the limb. When the maxilla is in a position of rest, i. e. pointing obliquely forward and outward the endites point about straight out to the sides, in other words they are placed about transversally to the longitudinal axis of the body. (Their position may perhaps best be illustrated by means of the annexed diagrammatic drawing, representing a horizontal section through this limb.) The basale is without traces of an endite. The exopodite is furnished with

three bristles. Of the two joints of the e n d o p o d i t e the proximal one is large and powerful; the distal one is directed somewhat inwards, small, but rather powerful, armed with numerous powerful bristles (with the exception of the males of the sub-family *Philomedinae*).

With regard to the differences between the previous authors' interpretations of the different parts of this limb and that which is followed in this work, see above p. 31.

F i f t h l i m b: — Cf. fig. IV, p. 39. With or without sexual dimorphism. — It is short, foliaceous and developed as a powerful masticatory organ. Exceptions are the males of the sub-family *Philomedinae*, in which this, like the preceding limb, is fitted with very weak masticatory parts and in which it can certainly not be used for mastication of food. The p r o t o p o d i t e is powerful, dominates somewhat over the exopodite, is united rather much with the body, is generally only rather weakly divided into two or three joints and is directed vertically. On the inner edge it is armed with three powerful, although rather slightly projecting endites, one on the pro-coxale, one on the coxale and one on the basale, all three of which are armed with bristles. The marginal bristles of the e p i p o d i a l p l a t e most frequently diminish rather regularly in length the more dorsally and ventrally they are fixed. The e x o p o d i t e is four- or five-jointed, directed obliquely backwards and outwards. Its two proximal joints are powerful and serve as masticatory organs, most frequently rather well defined both from each other, from the protopodite and from the third exopodite joint; on the inner edge both are furnished with a greater or less number of more or less powerful bristles, the proximal one has in addition a more or less powerful tooth, consisting of several constituent teeth placed in a row. The following exopodite joints generally differ very greatly in their structure from the two preceding ones, they are very slightly chitinized and take no part in the mastication of the food. The fourth joint is deeply sunk in joint no. 3, so that the latter is divided into an outer and an inner lobe, the connection of which is often to be seen only in rather young specimens; the inner lobe is sometimes more or less reduced. The e n d o p o d i t e not developed.

Fig. XXIV. — Horizontal section of the maxilla of a form belonging to the sub-genus *Vargula*, diagrammatic.

With regard to the differences between the interpretation of the different parts of this limb that have already appeared in the literature and the interpretation accepted in the present work see above p. 37.

S i x t h l i m b: — Cf. fig. VII, p. 48. Without or with rather weak sexual dimorphism. — It is always rather large yet rather moderately lengthened in the longitudinal direction of the body, directed ventrally. It consists of a rather well developed, more or less obviously two- or three-jointed p r o t o p o d i t e and a rather powerful e x o p o d i t e; the e n d o p o d i t e seems always to be lacking. P r o t o p o d i t e: Armed on the anterior edge with three endites, of which at least the two distal ones are well developed; one of these is placed on the basale, the two others on the procoxale-coxale. The endites are furnished with a varying number of bristles, most frequently rather powerful, some of which are placed distally, some medially, generally somewhat more proximally (measuring from the top of the

endites) than the former; the distal and the medial bristles generally are of different types. Distally on the posterior edge the protopodite has a reduced e p i p o d i a l a p p e n d a g e, generally represented only by a small number of short bristles. E x o p o d i t e: The proximal joint is comparatively short, well defined both from the protopodite and from the distal exopodite joint; it is armed on the anterior edge with a powerful endite, most frequently of about the same type as the distal endite of the protopodite. The distal exopodite joint varies somewhat in shape and size; furnished with a varying number of bristles along the ventral edge; of these bristles the posterior-distal ones are most often of a type differing somewhat from the rest inasmuch as they are densely plumose along almost their whole length. Sometimes this joint has a trace of an endite on the anterior edge; most frequently, however, it is quite without anything of this sort. The bristles of this limb seem to be subject to a somewhat greater variation than the bristles on the preceding limbs.

For the differences in the interpretation of the various parts of this limb in preceding authors and in the present work see p. 47 above.

S e v e n t h l i m b: — Without or with rather weak sexual dimorphism. — Armed distally with an unpaired comb, which is comparatively constant in type, is placed longitudinally, is more or less horse-shoe shaped and most frequently rather powerful; when the limb is held in its natural position of rest, i. e. directed upwards and curved backwards, the points of the teeth of the comb are directed upwards.

The b r u s h - s h a p e d o r g a n is lacking almost throughout.

P e n i s varying in type.

The u p p e r l i p varies in size and type, with a glandular field of varying size.

G i l l s are exceedingly seldom developed; situated dorsally at the back of the body.

Special terminology: — M a n d i b l e: — The two bristles situated dorso-distally on the basale are simply called: „the dorso-distal bristles".

F i f t h l i m b: — The large tooth on the first exopodite joint, composed of several teeth placed in a row, is called „the main tooth".

S i x t h l i m b: — Of the bristles of the endites the distal ones (distal-proximal is measured from the top of the endite to its base) are called „distal bristles", those placed medially, often somewhat proximally to the former, „medial bristles".

Natural arrangement of the two sub-families.

Remarks: I have had some doubt as to which of the two sub-families *Cypridininae* and *Philomedinae* should be placed first. In other words, which of these two groups is to be regarded as the most primitive?

It is certainly true that in several respects the sub-family *Philomedinae* is probably more primitive than the sub-family *Cypridininae*. Among its primitive characters may be mentioned:

the absence of suctorial organs on the end bristles of the male's first antenna,

the differentiation of the endopodite of the second antenna in the male into an organ for seizing the female,

the simple structure of the penis (cf., in addition, the remarks under *Cypridiniformes* above).

In a number of other characters it is, however, undubitably considerably more divergent than the latter group, for instance with regard to

the first antenna in the female,

the development of the second exopodite joint of the fifth limb into a huge tooth and especially,

the great sexual dimorphism, which is shown principally in the strongly reduction of all the masticatory organs in the males.

Under these circumstances it seems to me most convenient simply to follow G. W. MÜLLER in placing the sub-family *Cypridininae* first.

Can any of the forms so far described be regarded as a transitional type between these two sub-families?

G. S. BRADY's assumption, 1898, p. 437, that the genus *Pyrocypris* (*Cypridina*, s. str. sensu meo) would form a transitional type of this kind is of course due merely to this author's lack of sufficiently thorough knowledge of the forms belonging to it.

As early as in his work of 1880, p. 158, the same author suggested that the genus *Crossophorus* would resemble the genus *Philomedes*. This assumption has since been repeated by G. O. SARS, 1887,* p. 11. G. W. MÜLLER, 1890, p. 226 expresses himself, however, more cautiously in this matter; he writes: „Ueber die Stellung der Gattung *Crossophorus* BRADY wage ich kein Urtheil auszusprechen . . . . SARS glaubt, daß die Gattung näher verwandt ist mit *Philomedes*, wofür auch einige Thatsachen sprechen würden." It seems at present to be rather difficult to decide whether this opinion of G. S. BRADY and G. O. SARS is justified. It may, however, be pointed out that the characters by which *Crossophorus* seems to approach *Philomedes* are probably to be regarded as being comparatively old. Of these characters we may mention here the absence of suctorial organs on the end bristles of the first antenna, the development of the endopodite of the second antenna in the male into a clasping organ and perhaps also the rather deeply bifurcated endite on the coxale of the mandible, cf. p. 171 above. — In any case the genus *Crossophorus* does not form any unaltered transitional type between these two sub-families.

As far as I know there is so far no form described which may be pointed out as a certain connecting link between these two groups. It is, however, impossible to answer this question with any certainty on account of the incompleteness and uncertainty of most of the descriptions hitherto published.

* See also C. CLAUS, 1888, p. 151.

Sub-Family Cypridininae.

Sub-Fam. *Cypridininae*, G. W. MÜLLER, 1912, p. 8.

Description: — Shell: — Sexual dimorphism, in most cases, weak, sometimes scarcely noticeable or even entirely undeveloped. — The type of shell varies very much. The surface sculpture is, in most cases, not at all or else rather weakly developed. Seen from inside: The part of the shell between the list and the posterior margin is flattened in most forms, not curved inwards in the shape of a siphon, so that, when the shell is closed, the two valves are here pressed rather close to each other; an exception to this last rule among the forms so far certanly known is the sub-genus *Siphonostra*, cf. below; to judge from the descriptions it seems, hoiwever, to be possible that other forms as well are distinguished by a similar peculiarity. Hinge very seldom with teeth.

First antenna: — With rather considerable sexual dimorphism.

Female: — Most often with eight joints, less often with seven owing to a more or less complete union of the fifth and sixth or the seventh and eighth joints, or it may even have only six owing to a more or less complete union of both the fifth and sixth as well as the seventh and eighth joints. The proportion between the joints seems to be subject to but slight variation; the following are the usual proportions (the figures are from measurements of *Cypridina [Doloria] levis*):

$$\text{I } \tfrac{17}{14};\ \text{II } \tfrac{23}{13};\ \text{III } \tfrac{6}{3};\ \text{IV } \tfrac{10}{10};\ \text{V } \tfrac{6}{6};\ \text{VI } \tfrac{3}{3};\ \text{VII } \tfrac{1}{1};\ \text{VIII } 0{,}5.$$

When in the descriptions of the forms belonging to this sub-family no special information is given as to these proportions the form in question agrees pretty nearly with the example given above. All the forms of this group investigated by me showed the same number and also almost exactly the same situation of the bristles. All the characters of the bristles given below are to be taken as common to all these forms. To judge from the literature, the type described here seems, however, not to be quite general; the genus *Crossophorus*, for instance, is an exception (cf. G. W. MÜLLER, 1906a, pl. XXXIV, fig. 4). The second joint is quite without bristles; the third joint has two bristles, one placed anteriorly and one posteriorly-distally; the fourth joint also with two bristles, one placed anteriorly-distally and one posteriorly-distally. All these bristles, like the single bristle on the original sixth joint (see above, p. 174) are simple, pointed, annulated, naked or with only short and usually very fine secondary hairs; they are comparatively short or of moderate length and, as far as I have observed, never differentiated into specific sensory organs. The sensory bristle of the fifth joint is always very powerfully developed; its proximal part is strongly annulated, the annulation becoming more and more fine distally and sometimes quite disappearing, in which case the end of the bristle seems quite hyaline; the filaments of this bristle are also finely annulated or distally even quite hyaline; distally both the principal bristle and the filaments are finely rounded and furnished with a short, fine sensory hair. The original seventh joint has three distal bristles, situated in about the position shown in fig. 16 of *Cypridina (Vargula) norvegica*, in other words one is

situated on the anterior edge, one medially, somewhat anteriorly and one on the posterior edge of the joint. Of these three bristles the first-mentioned is relatively short or of moderate length and of about the same type as the bristles on the third, fourth and the original sixth joints; the two other bristles are generally of about the same type as each other, typical sensory bristles, rather powerfully annulated proximally, more and more finely annulated distally, near the point sometimes even quite hyaline, characterized by simple, fine sensory filaments, generally of about the same thickness throughout their whole length, situated dorsally and distributed fairly equally along the greater part of the length of the bristles. Like the distal part of the principal bristles these sensory filaments are very finely annulated or even quite hyaline; in addition, like the principal bristles they are finely rounded distally and furnished there with a short, fine sensory hair. The one of these bristles that is situated medially, somewhat anteriorly, is of moderate length and fitted with relatively few sensory filaments; exceptionally, for instance *Cypridina (Cypridina) serrata* (G. W. MÜLLER) var. *affirmans*, ♀, (cf. the description of this form, given below) it is even quite without any appendages; the posterior one of these bristles is comparatively long and furnished with a relatively large number of filaments. The small (original) end joint has four bristles. Two of these, situated close to each other distally-laterally on the joint, are of quite the same type, narrow or moderately thick, distally rounded sensory filaments, of about the same thickness throughout; proximally they have rather powerful annulation, distally with increasingly close and fine annulation or more or less completely hyaline; both are quite naked. The remaining two bristles, both comparatively long, are of about the same type as the posterior bristle on the preceding joint; they both issue distally-medially, one a little in front of the other.

Male: — Often more extended than that of the female. The sensory bristle of the fifth joint is developed in about the same way as in the female, with exactly the same or else with only an insignificantly larger number of sensory filaments. Of the bristles of the original seventh joint the posterior and the one placed distally-medially and somewhat anteriorly are, in almost all genera so far known (exception: *Crossophorus*), furnished with suctorial organs for seizing the female. (These suctorial discs were interpreted by G. O. SARS, 1887, p. 39, as sensory organs — he writes: „et eiendommeligt klart, baegerformet Appendix, aabenbart of sensorisk Natur"* — a view which has, however, not been accepted by succeeding writers. It had already been interpreted correctly by C. CLAUS, 1873, p. 221.) The different genera vary not inconsiderably with regard to the type, number and arrangement of these suctorial organs. As in the females the two bristles in question differ from each other in their length; the one that is situated distally-medially and somewhat anteriorly is comparatively short in this sex as well, the other is long. Sometimes the bristles of the seventh and eighth joints are of about the same length in males and females, sometimes two or three of them are more or less lengthened in the former sex. This lengthening is found in different bristles in different forms; in some forms the posterior bristle on the original seventh joint and the anterior one of the two distal-medial bristles of the eighth joint are lengthened, in others it is both the distal-medial bristles of the eighth joint and in others all these three bristles.

* Translation: „A peculiar hyaline, cup-shaped appendix, evidently of sensorial nature "

S e c o n d a n t e n n a: — In some forms with sexual dimorphism, in others it is without or almost without it; in most cases it is somewhat more powerfully developed in the males than in the females. — E x o p o d i t e: This branch usually shows a very close agreement in the two sexes. Of about the same length as the protopodite. The proportion between the joints, which always seems to be about the same in males and females, certainly varies a little, but the variations are rather slight. The first joint often attains to about the total length of all the succeeding joints, the second joint is about as long as the total length of the two or three following joints, the third and fourth joints are of about the same length. The first joint has no bristles. The bristle of the second joint is relatively short in comparison with those of the following joints, generally not much longer than the total length of the seven distal joints of this branch, and in some forms even almost completely reduced; in addition this bristle has no natatory secondary hairs, it is either naked or in most cases armed with a varying number of short and more or less powerful, smooth spines and —at least in all the forms of this sub-family described in this work — fitted at the top with a very short and fine hair (sensory hair?). The bristles of the third to the eighth joints are developed into long natatory bristles, usually fitted with secondary natatory hairs along the greater part of their length. In a few forms some of these bristles are armed with short and more or less powerful spines along a part of their length. In all the forms of this sub-family that are described in this work the distal part of the natatory bristles was more or less hyaline, somewhat rounded at the point and there fitted with a short and very fine (sensory?) hair. The end joint usually has four bristles, in a small number of forms only three and in exceptional cases, as, for instance, in the genus *Crossophorus*, a somewhat larger number. Of these four bristles the two ventral ones are long and powerful natatory bristles, not at all or else only rather slightly shorter than the bristles on the third to the eighth joints. The two dorsal ones of them, especially the one situated most dorsally, are, on the other hand, as a rule rather considerably shorter — their length varies, however, pretty considerably in different forms — and generally fitted with a few short secondary hairs; in some forms, however, these bristles too carry numerous long natatory hairs. In most species smooth basal spines are developed; the end joint is also armed with such a spine. Medially-distally on the third to eighth joints there is usually a series of spine- or hair-like formations, situated more or less closely together, usually rather fine, short, more or less hyaline, most frequently rather difficult to discover; this character seems to vary pretty considerably, so that it is scarcely practical for characterizing the genera and species; nor has it been included in the descriptions given below of forms belonging to this sub-family. E n d o p o d i t e: This branch sometimes shows strong sexual dimorphism, sometimes, however, it is developed similarly in both sexes. In a number of forms it is developed into a powerful three-jointed clasping organ in the male; it is usually rather long and distinctly three-jointed, sometimes more or less rudimentary, verruciform and quite unjointed.

M a n d i b l e: — This limb is either without, or in some cases with only very weak, sexual dimorphism. It is comparatively long and slender. The endopodite is moderately flattened at the sides, its second joint generally considerably narrowed distally. The proportion between the joints, which seems to be about the same in

all species, is illustrated by the following figures (taken from measurements of *Cypridina (Doloria) levis* [illegible]):

Pr. I [illegible]; Pr. II [illegible]; End. I $\frac{7}{4}$; End. II [illegible]; End. III $\frac{2}{2}$.

P r o t o p o d i t e: Coxale: The endite is always well developed in both males and females, simple or usually weakly bifurcated distally, sometimes, as, for instance in the genus *Crossophorus*, even rather deeply bifurcated*; it is fitted with a varying, generally very large, number of smooth spines, varying in strength and manner of arrangement; in the cases when it is bifurcated distally the two distal points are almost always armed with lateral spines. [Exception among the species seen by me: *Monopia (Cypridinodes) acuminata*]. Dorsally at the base of the endite there is, in addition, (always?; observed in all the species of this sub-family described in this treatise) a single, short bristle. Apart from this this joint seems always to be entirely without bristles (with the exception of the genus *Crossophorus*, see G. S. BRADY, 1880, pl. XXXVIII, fig. 6). Basale: The bristles on this joint are certainly subject to variation both as to their number and development, but, as far as I have found, the variation is, in most forms, rather insignificant. Along the ventral side of the joint the bristles are comparatively few in number, usually about six to nine, in exceptional cases, as, for instance, in the genus *Crossophorus*, somewhat more. The situation of these bristles in the species examined by me was pretty constant and as follows: One group is placed in the proximo-ventral corner of the joint, somewhat medially; somewhat distally of this group and somewhat laterally, there is often a single bristle; a little proximally of the middle of the joint there are a couple of bristles and somewhat distally of this point a couple more. Dorsally this joint seems in most cases to have only three bristles, viz. the two dorso-distal bristles which are, as is pointed out above, characteristic of the whole family and another one, placed about at the middle of the joint or a little in front of this point. In the genus *Crossophorus*, however, the latter bristle is replaced by a whole series of rather long and powerful bristles. E x o p o d i t e: Most frequently about as long as or very slightly shorter or longer than the anterior side of the first endopodite joint; it is drawn out to a rather fine point and has dorso-distally a sort of cushion of rather short, exceedingly fine hairs placed closely together in a ring (exits of the glandular cells). E n d o p o d i t e:

* In a number of forms, in which this endite is only weakly bifurcated, for instance in *Cypridina (Cypridina) serrata* var. *affirmans* (cf. below, fig. 9 of this form), there is between the two distal points a more or less well-developed spine-shaped or verruciform process. In other forms, in which this endite is more deeply bifurcated, this process is entirely absent. To judge from its situation, this process may possibly be interpreted as the original point of the endite. The two comparatively powerful points on each side of the process in question would according to this point of view be considered as having presumably arisen by two of the distal spines with which the endite is more or less copiously furnished having developed more powerfully than the others. According to this opinion this endite originally would have been characterized by a simple point in this group of animals.

There are also, however, facts that seem to argue against this interpretation. First this endite is deeply bifurcated in *Philomedinae*, *Sarsiellidae* and *Asteropidae*, thus in all the remaining groups of *Cypridiniformes* in which it is developed, and secondly it is most deeply bifurcated (about the same as in *Philomedinae*) in that genus of the sub-family *Cypridininae (Crossophorus)* which we have rather strong reasons to regard as the most primitive. An additional argument against the assumption that the two distal points are to be regarded as a couple of spines seems to me to lie in the fact that these points, even in species in which they are comparatively weakly developed, are almost always armed with secondary spines contrary to the other spines of this endite which are all perfectly smooth (exception: *Monopia (Cypridinodes) acuminata*).

It may, however, be impossible at present to decide with certainty which of these two alternatives is the correct one.

First joint: In all the forms of this sub-family examined by me the bristles were confined to a single group of four bristles, placed ventero-distally on the joint; in exceptional cases this group contains a somewhat larger number of bristles (the genus *Crossophorus*, see G. S. BRADY, 1880, pl. XXXVIII, fig. 6). The length of these four bristles was, as a rule, fairly constant in the species investigated by me; apart from a rather slight individual variation they had in most of these species about the following proportions: The two ventral were either about the same length or of somewhat different lengths, comparatively long, about as long as or somewhat longer or shorter than the length of the posterior side of the second endopodite joint; of the two remaining bristles one was about as long as the proximal breadth of the second endopodite joint, the other was exceedingly short, sometimes rather difficult to get sight of. Second joint: This joint is armed anteriorly with a larger or smaller number of bristles placed closely together, of which the proximal ones are always situated a little way from the proximal boundary of the joint and the distal ones somewhat from the distal boundary. Among these bristles there are some, situated on the anterior edge of the joint, with short and fine hairs; others, situated on the medial side of the joint, mostly somewhat posteriorly of the former bristles, are generally comparatively shorter than these and fitted with rather fine or more or less powerful hairs or spines, placed closely together and arranged in the shape of a feather; these latter bristles seem presumably to function as a sort of cleaning organ. Posteriorly this joint has always only a few short, generally naked or almost naked bristles, placed distally to the middle of the joint. Of these bristles the two distal ones are always situated close to each other; in some of the species of this sub-family described in this treatise the medial one of the two bristles last mentioned showed sexual dimorphism, being a little, sometimes considerably, more powerfully developed in the males than in the females [see figs. 12 and 13 of *Cypridina (Vargula) norvegica*]. The little end joint is most frequently (as in the sub-family *Philomedinae*) furnished with seven bristles, of which even the longest are relatively short, as a rule not exceeding half the length of the second endopodite joint. The relative strength and the mutual proportion of these bristles is subject to rather great variation; in most cases, however, the two middle ones are claw-shaped, a good deal more powerful and somewhat longer than the rest; the three posterior ones are, on the other hand, weak, the most posterior one, as a rule, even exceedingly weak and short; of the two situated anteriorly one is, as a rule, more or less claw-shaped, the other weak.

Maxilla: Without or at any rate with only scarcely discernible sexual dimorphism. — Protopodite: The basale is rather small or of moderate size and most often more or less closely united to the first endopodite joint. The three well-developed masticatory processes are most frequently immoveably joined to the procoxale and the coxale. Only in exceptional cases is the part they all emerge together from developed as an appendage with an independent power of motion (see the sub-genus *Cypridinodes* in this treatise). The species of this sub-family investigated by me showed the following numbers of distal bristles on the masticatory processes: On the first masticatory process 7—13, on each of the second and third processes 5—7 bristles. These bristles are modified somewhat differently in the different species, but within each species they show, on the other hand, a rather striking constancy; they are often armed at about the middle with rather long and stiff, secondary bristles arranged

more or less clearly in wreaths and are more or less strongly pectinated distally. Proximally on the outside of the third masticatory process there is usually a single bristle. The coxale often has dorsally a lamelliform e p i p o d i a l a p p e n d a g e, often fine-haired, and distally of this often a single bristle. On the boundary between the protopodite and the endopodite there are often some bristles to be found: one placed just close by the exopodite, one at about the middle of the inside of the endopodite and one on the anterior edge of the latter; sometimes a somewhat larger number of bristles is developed at this place. E x o p o d i t e: This branch is most frequently to be found at its original place, distally-laterally on the basale, seldom (in the sub-genus *Cypridinodes*) displaced distally. E n d o p o d i t e: The first joint is generally of moderate length, but very broad and rather strongly compressed laterally-medially (the limb is thought of as turned straight outwards). Its posterior edge is most frequently more or less strongly chitinised distally, often more or less projecting and forming a sort of cutting edge; the shape of this part varies somewhat both in different species and within each species, so that it is scarcely suited for the characterization of species. Distally this joint has some bristles both on the anterior and the posterior edge, often two on the anterior and two or three on the posterior. The small end joint is often rather strongly chitinized and armed with a rather large number of bristles. In most of the species of this group that I have had an opportunity of closely investigating these bristles showed such strong agreement both in number and situation that it ought to be possible to carry out a pretty certain homologization of them in the different forms. In most species 13 bristles were found, placed as follows: One group, whose bristles (often four in number) form a transverse row, is found on the outside of the joint, somewhat towards the back; its bristles are most frequently of moderate strength and diminish somewhat in length towards the anterior edge of the joint; they are also but weakly or else not at all armed. The other bristles are situated more or less distinctly along the distal edge of the joint and are very different from each other in size and type in the different species; within each species they show, however, a rather great constancy, so that fairly good classificatory characters may be obtained from them. In most species some of them at least are developed into very powerful masticatory bristles. A group of these bristles is placed distally-anteriorly on the joint; it consists most frequently of three bristles. Distally-medially on the joint somewhat behind this group there is another group; it too has in most cases three bristles. Finally, posteriorly-distally on the joint, usually somewhat laterally to the last-mentioned group, there is a third group of three bristles, generally including the most powerful masticatory bristles of this joint. While the first group mentioned is comparatively isolated, the three latter groups are at no great distance from each other, on the contrary they are in most species rather close to each other, sometimes (as, for instance, in the sub-genus *Cypridinodes*, see below) even so close to each other that I could carry out homologization only with the greatest hesitation.

F i f t h l i m b*: — Without sexual dimorphism or at least the dimorphism is extremely weak, scarcely noticeable. — The p r o t o p o d i t e: The first masticatory process is armed with a somewhat varying number of bristles: 5—14 (generally 7—9) were found in the species

* It is to be noted that in the description, for practical reasons, this limb is always thought of as pointing straight outwards, whereas in the natural position of rest it points obliquely outwards and backwards.

of this sub-family that are described in this treatise. The type of these bristles is somewhat different in different species; within each species, on the other hand, they seem to be characterized by rather great constancy. They are most frequently arranged in a transverse row, sometimes, however, as in the genus *Gigantocypris*, in two closely set and parallel rows. Second masticatory process: In all the forms of this group that I have examined with the same number of bristles: Five placed in a rather close transverse row on the inner edge of the process and one, usually very short and weak, placed at some distance from the others on the anterior side of the limb. Together with this uniformity with regard to number there is the comparatively slight variation with regard to type that these bristles are subject to within this sub-family. Third masticatory process: This, too, has a quite uniform number of bristles in all the species of this group investigated by me. There are seven bristles arranged in a somewhat irregular, transverse row; these bristles also show within this group a comparatively slight variation with regard to type. The bristles on the two last-mentioned masticatory processes show, with regard to their types, a not inconsiderable mutual parallelism, the types found on the one reappear, with comparatively slight variation, at about the corresponding places on the other. Distally on the anterior side, near the outer edge of the limb, the protopodite generally has an irregular, powerful spine which forms, so to speak, a ventral conclusion of the chitinous skeleton of the epipodial plate (this spine seems never to be present in the sub-genus *Cypridina*, cf. below); dorsally, too, the chitinous skeleton of the epipodial plate has an irregular swelling (not, however, freely projecting as the ventral spine). The e x o p o d i t e has four or five joints. The two proximal ones (developed as powerful masticatory organs, see the diagnosis of the family) are of about the same strength and size, the distal one of them not developed into a powerful, tooth-like process. First joint: The main tooth, the most important masticatory organ of this limb, is fixed transversally and somewhat obliquely on the joint and is always very large and powerful. It seems to be subject only to comparatively slight variation within the sub-family. In all the species of this group described in this treatise it is composed of six to eight, usually seven, constituent teeth; of these the one situated most anteriorly is the longest and most powerful, the rest diminish fairly uniformly in length according as they are situated more posteriorly. The strength of these teeth also diminishes somewhat, even though sometimes only very slightly, according as they are situated more posteriorly. The posterior one of them is short, conical and smooth, the others are bent somewhat backwards and armed along the concave posterior edge with numerous rather powerful teeth, placed close to each other. This joint has also a number of bristles: In all the species of this sub-family that were investigated by me a single bristle was found on the posterior side of the joint, close to the main tooth, and a number of bristles placed in a transverse row on the anterior side of the joint (in most species two of the latter were situated close to the main tooth, one farther out on the limb, a short distance from the former). Second joint: On the inner edge armed with a large number of bristles. Some among these, situated next to the main tooth of the preceding joint, somewhat posteriorly on the joint, are, like the constituent teeth of the main tooth, arranged in a close row, running obliquely and transversally on the joint and are distinguished by their strength; the anterior one of them is rather long, the others decrease fairly uniformly in length according as they are situated more posteriorly; they are

armed with powerful lateral teeth, of which the distal ones, beginning first a little way from the point of the bristle, are usually the most powerful; they are never furnished with long, stiff side-bristles and in most cases, contrary to all the other bristles of this joint — and most of the bristles on this limb — they are not annulated. — G. W. MÜLLER makes these bristles form a „tooth" together, comparable to the „main tooth" of the preceding joint; see G. W. MÜLLER, 1912, p. 9, fig. 7. I have not considered that I ought to follow this method of procedure — although it is comprehensible — because these bristles do not together form quite so pronounced a morphological unit as do the bristles through the union of which the „main tooth" must be regarded as having arisen. They are, on the contrary, quite free basally, at least in all the species of this sub-family that I myself have had occasion to investigate. — Somewhat outside and in front of these bristles there is a somewhat irregularly arranged collection of, for the most part, rather long and powerful, strongly pectinated bristles; in these, too, the anterior ones are rather considerably longer than the posterior ones; in addition the inner ones of them are most frequently somewhat longer than the outer ones; their pectination, which continues right to the point of the bristles, is somewhat weaker distally than in the middle; like the bristles in the last-mentioned group these bristles, too, are without long secondary bristles (one exception: *Cypridina (Cypridina) serrata* var. *affirmans*). Besides these bristles there are in all the species of this sub-family described in this treatise two additional bristles on this joint, one close to the last-mentioned group of bristles on the posterior side of the joint and one on the anterior side of the joint close to the following joint. The two or three distal joints are fitted with a somewhat varying number of generally rather weak bristles.

Sixth limb: — Without or at any rate with only very weak sexual dimorphism. — It varies rather much in type.

Seventh limb: — This has no or only very weak sexual dimorphism. — The number of the cleaning bristles varies very much: in some species there are only a few (8—10), in others they are very numerous, as many as a few hundred being found. The teeth of the end comb vary similarly very greatly in number; while in some species only a small number (5—6) are to be found, they are in other forms very numerous (100—150); their usual number is about 14—20. Within each species the variations in number of the cleaning bristles and the teeth of the end comb are rather limited. In most forms the distal teeth of the end comb are distinguished from the proximal ones by their type. The former are in most cases somewhat longer and narrower than the latter and are rounded or even pointed distally; the latter, which are situated proximally close to the former about symmetrically on each side of the extremity, are distally cut off more or less sharply. In other respects the distal part of this limb varies somewhat in type.

The brush-shaped organ is very seldom found; among all the species of this sub-family included hitherto in the literature only the female of *Cypridina squamosa* G. W. MÜLLER has been established as possessing it; cf. G. W. MÜLLER, 1894, pl. 2, fig. 31. I have not succeeded in finding this organ in either the males or the females of any of the species of this sub-family that are described in this treatise.

P e n i s: — Although it is subject to considerable variation, this organ seems to be formed on the same fundamental type within the whole of this sub-family. It is oval, very strongly musculated and in most cases of considerable size. Distally it is split in the shape of tongs; the ventral leg of the tongs is often larger than the dorsal one and is rounded distally; the dorsal leg, which is moved by powerful muscles, varies in shape; in most cases it is sickle-shaped, curved ventrally and rounded distally. When the dorsal leg of the tongs is pressed against the ventral one it is situated most frequently medially to the latter. Large or small glands are often to be found in the penis. In addition there are also at different places on this organ large or small groups of short bristles. As a support a powerful chitinous skeleton is developed, varying somewhat in different species. The dorsal leg of the tongs articulates to the dorso-distal part of this skeleton.

F u r c a: — In some, presumably the majority, of the species of this group this organ agrees in males and females, in others it shows weak or sometimes even not inconsiderable sexual dimorphism. — The type of the lamellae varies somewhat in different forms, but seems to be fairly uniform within each genus. The number of the claws is also subject to a rather considerable variation; in some genera it seems to be quite uniform, in a number of forms it varies somewhat, even within the species; usually the number varies between four and twelve; sometimes, however, as in the genus *Crossophorus*, a somewhat larger number is found. In some species main claws and secondary claws can be distinguished, in others it is impossible to carry out this division. The armament of the claws seems to be very similar; at least in the species belonging to this group that were examined by me there was very little variation shown in this respect. Each claw is armed ventrally along the greater part of its length with two rows of teeth situated rather close together, one row running somewhat laterally, the other somewhat medially; on the posterior claws the teeth are somewhat weaker than on the anterior ones, otherwise they are of about the same size and shape as each other, conical, pointed distally, smooth, and pointing obliquely ventrally-distally. The distal teeth in the medial row of the distal (= first) claw are, however, exceptions; these teeth differ from the others partly because they are considerably stronger, partly because they are displaced dorsally and point almost straight distally; see fig. 24 of *Cypridina (Macrocypridina) castanea*. The distal part of the claws is sometimes smooth, sometimes the teeth continue right out to the point of the claws; this condition is, however, often somewhat variable even within the species. Dorsally the claws are most frequently furnished with fine hairs or else almost smooth. Between the claws and basally on them there are no long, stiff bristles.

The u p p e r l i p is large and more or less strongly helmet-shaped. Numerous glands open on it; the glandular field varies very much in type, often more or less distinctly tripartite. — Similar in males and females.

The r o d - s h a p e d o r g a n, m e d i a n e y e a n d l a t e r a l e y e s vary in development and type.

G i l l s are found, but only exceedingly seldom (*Cypridina Hilgendorfi* G. W. MÜLLER, ♂).

Special terminology: — In a number of cases when, on account of striking agreements both with regard to number and situation, I thought I could carry out a safe

homologization of the bristles. I have, for the sake of brevity, simply denoted the latter by letters in the descriptions that follow.

F i r s t a n t e n n a: — The bristles on the original seventh joint: The one situated anteriorly = „the a-bristle“; the one placed distally-medially and somewhat anteriorly = „the b-bristle“; the posterior-distal one = „the c-bristle“. The four bristles on the original eighth joint: The anterior of the two simple sensory filaments which are situated laterally, close to each other, is called „the d-bristle“, the posterior one of them is called „the e-bristle“; of the two distal-medial bristles, the anterior one is called „the f-bristle“, the posterior one = „the g-bristle“; see the fig. 16 of this limb of *Cypridina (Vargula) norvegica.*

M a n d i b l e: — The ventral bristles on the basale have in the following descriptions been denoted by the following letters: The group of bristles proximally-ventrally-medially = „the a-bristles“; the solitary bristle, somewhat distally of this group = „the b-bristle“; the bristles situated somewhat proximally of the middle of the joint = „the c-bristles“; those situated somewhat distally of the middle of the joint = „the d-bristles“. Of the bristles on the second endopodite joint the comparatively short ones, armed with more or less powerful secondary bristles and situated anteriorly-medially on the joint are called after what is presumably their function often simply „cleaning bristles“.

M a x i l l a: — Bristles of the end joint: The group whose (often four) bristles form a row placed across the outside of the joint, somewhat posteriorly and somewhat proximally to the distal edge of the joint is called „a-bristles“; the group distally-anteriorly = „b-bristles“; the group distally-medially, somewhat behind the last-mentioned group = „c-bristles“; the remaining bristles, situated posteriorly-distally on the joint, somewhat laterally = „d-bristles“.

F i f t h l i m b: — Second joint of the exopodite: The bristles in the group which was interpreted by G. W. MÜLLER as a „tooth“, comparable morphologically with the „main tooth“ on the preceding joint, are called „a-bristles“; the irregular group of bristles somewhat outside and in front of the „a-bristles“ = „b-bristles“; the single bristle close to this group on the posterior side of the joint = „c-bristle“; the bristle on the anterior side of the joint close to the third exopodite joint = „d-bristle“.

S e v e n t h l i m b: — Of the teeth of the end comb the distal ones, those of the more or less extended type, are denoted „distal teeth“, the ones situated proximally to the former are called „proximal teeth“.

Remarks: — Although a great number of the forms of this sub-family that have hitherto been introduced into the literature are very incompletely and vaguely described, we may, all the same, say with rather great certainty even now that this group is, from a classificatory point of view, to be regarded as being fairly uniform. On the other hand it must, however, be pointed out that, compared with the sub-family *Philomedinae*, it comprises rather heterogeneous elements.

Are the genera natural units?

Are the genera that have been so far established of this sub-family in their modern conception to be looked upon as natural, well-defined systematic units?

So far seven* genera of this group have been established, namely:

Cypridina, H. MILNE EDWARDS, 1840.

*Monopia***, C. CLAUS, 1873.

Crossophorus, G. S. BRADY, 1880.

Pyrocypris, G. W. MÜLLER, 1890 (= *Eupathistoma*, G. S. BRADY, 1898, p. 437).

Gigantocypris, G. W. MÜLLER, 1895.

Codonocera, G. S. BRADY, 1902 a.

Cypridinodes, G. S. BRADY, 1902 a.

Of these it seems as if the genera *Crossophorus*, *Gigantocypris* and *Codonocera* may without hesitation be characterized as natural classificatory units, well defined from each other and from other genera, as has already been pointed out by G. W. MÜLLER, 1906 b, pp. 12 and 13.

The genus *Pyrocypris* (= *Cypridina*, s. str., et s. meo) comprises a rather large number of very closely related species. These species are presumably more closely related to the forms that have been grouped by G. W. MÜLLER under the name of *Cypridina* than are the three above-mentioned genera *Crossophorus*, *Gigantocypris* and *Codonocera*. This does not, however, prevent their breaking-out as a higher systematic unit from being considered as quite justified. G. W. MÜLLER himself seems, however, to have had doubts as to the correctness of establishing this genus; he writes on this point, 1906 b, p. 13, as follows: „Die Gattung *Pyrocypris* . . . . steht der Gattung *Cypridina* s. str. viel näher als die genannten" *(Crossophorus, Gigantocypris* and *Codonocera)*, „man kann in Zweifel darüber sein, ob nicht manche Vertreter von *Cypridina* ihr näher verwandt sind als anderen Vertretern der Gattung, und ob ihre Abtrennung die natürliche Verwandtschaft zum Ausdruck bringt." Then he adds: „Auf jeden Fall vereinigt sie eine größere Zahl nahe verwandter Form, läßt sich auch scharf characterisieren." — In his last large synoptic work on the Ostracods, 1912, this investigator certainly quite correctly retains this unit, in spite of this doubt of his. In the present work I have followed him in this procedure with the exception that the group in question has been considered a sub-genus of the genus *Cypridina****.

Of the three remaining genera, *Cypridina*, *Monopia* and *Cypridinodes*, G. W. MÜLLER always rejects the two latter; all three are united by this author under the generic name *Cypridina*. He gives the following reasons for this method of procedure of his (1906 b, p. 13): „Anders ist es bei den folgenden Gattungen: *Monopia* CLAUS charakterisirt durch das umfangreiche Frontalorgan. Berücksichtigen wir nur das Frontalorgan, so reißen wir nächst verwandte Formen, wie z. B. *C. flaveola* CLAUS und *favus* BRADY (= *Cypridinodes favus* BRADY) auseinander. BRADY hat l. c. die Gattung *Cypridinodes* aufgestellt, doch beruht seine Charakteristik ganz oder fast ganz auf Beobachtungsfehlern: an der Maxille sind die auch bei anderen Vertretern der Gattung *Cypridina* kurzen Kaufortsätze der Maxille abgerissen, der schlanke Maxillartaster

* With regard to the genus *Heterodesmus*, G. S. BRADY, 1868 b, cf. below under the sub-genus *Siphonostra*.

** In a later work, 1891 b, note p. 10 C. CLAUS altered this name to *Eumonopia* „da LUBBOCK bereits früher eine Pontelliden-Gattung *Monops* genannt hatte". There seems to me to be no reason for following this change of name.

*** With regard to the name of this sub-genus see below p. 192.

allein gezeichnet, er findet sich in gleicher Form z. B. bei *Cypridina asymmetrica*, die eigenthümlich knotige Bewaffnung der Zahnborsten des 1. Thoraxbeines (2. Maxille) dürfte das Resultat einer perspectivischen Verkürzung sein, beim 2. Maxillarfuß dürften sich die beiden dicken nach hinten gerichteten Borsten (vergl. Taf. 6, Fig. 7) derart aneinandergelegt haben, daß sie für einen oberflächlichen Beobachter wie ein Fortsatz erscheinen. Wollen wir die fragliche Form aus der Gattung *Cypridina* entfernen, wofür allerdings BRADY's Diagnose keinerlei Anhalt gewährt, so müssen wir sie mit *Monopia* vereinigen, doch müßte dann die Diagnose dieser Gattung ganz anders lauten."

Is *Cypridina*, in the conception that G. W. MÜLLER has given to this genus, to be regarded as a classificatory unit as homogeneous and as well-defined as the other genera of this sub-family?

The incompleteness and incorrectness that are characteristic of the descriptions of the majority of the species belonging to this genus result in our being able at present to submit these forms to only a comparatively superficial comparative investigation. But even a rather superficial study of them is, however, sufficient to show us that this genus comprises rather heterogeneous elements. It seems to have been a sort of lumber-room in which were thrown together all the forms that it was impossible to arrange under any of the genera *Crossophorus*, *Pyrocypris*, *Gigantocypris* and *Codonocera*. — G. W. MÜLLER himself has pointed out the unnatural character of this genus and the urgency of splitting it up into smaller systematic units. Statements pointing in this direction are found both in this author's work of 1906 a (p. 130) and in that of 1906 b (p. 13). In the former we read (loc. cit.): „Die Gattung umfaßt auch nach Ausscheidung einiger aberranten Formen noch recht heterogene Elemente. Eine Auflösung der Gattung in natürliche Gruppen erscheint dringend erwünscht, aber zur Zeit nicht durchführbar."

Is there any form or forms that can be said to contribute more than others to making this genus heterogeneous?

This question must be answered in the affirmative.

Cypridina asymmetrica G. W. MÜLLER is in a great number of the characters of the shell, maxilla, sixth and seventh limbs, furca and upper lip decidedly opposed to the great majority of the species included in this genus. To this species *Cypridina Bairdi* G. S. BRADY and *C. favus* (G. S. BRADY) (= *Cypridinodes favus)* certainly appear to be rather closely related. Unfortunately these two species are very incompletely known. In *C. Bairdi* we only know, out of the organs in question, the shell, maxilla and furca, and these show very great agreement with the corresponding organs in *C. asymmetrica*. In the case of *C. favus* we know, out of the organs mentioned, the shell, maxilla, sixth and seventh limbs and the furca; of these the shell (as I myself have verified during my re-examination of the type-specimen of this species; see below, note on the sub-genus *Cypridinodes)* the maxilla, seventh limb and furca show close agreement with the corresponding organs in *C. asymmetrica*; the differences with regard to the sixth limb are, as G. W. MÜLLER has pointed out, probably due to incorrect observation on the part of G. S. BRADY. These three species certainly constitute a distinct and quite natural group. G. W. MÜLLER seems already to have verified this; in this investigator's work of 1912 these three forms are placed together. To place them in the genus *Cypridina* (sensu G. W. MÜLLERI) seems undoubtedly to be a mistake.

The fact that, in spite of this, G. W. MÜLLER chose this course is due, as is shown by the quotation given above, partly to the incompleteness, uncertainty and undoubted incorrectness of several of the characters included in the diagnosis of the genus *Cypridinodes* given by G. S. BRADY, partly perhaps, above all, to the strange form *Monopia flaveola* described by C. CLAUS, 1873.

G. W. MÜLLER's criticism of G. S. BRADY's diagnosis of the genus *Cypridinodes* is undoubtedly quite justified. From this, however, it by no means follows that we are justified in including the three species mentioned above in the genus *Cypridina* (sensu MÜLLERI)!

In several respects — such as the type of the shell, the sixth and seventh limbs, the furca and the upper lip — *Monopia flaveola* agrees so strikingly with the three species mentioned that there can scarcely be any doubt of the existence of a real relationship.

Under these circumstances is it not most convenient to follow G. W. MÜLLER's indication, quoted above, that, in the case of an eventual breaking-out of *Cypridina asymmetrica*, *C. Bairdi* and *C. favus* we should unite these forms with *Monopia flaveola* into one genus, *Monopia*?

I think this is true only with an important restriction. Although *Monopia flaveola* — as is mentioned above — shows in several respects rather far-reaching agreement with the three species in question, yet it differs from them in several characters of such importance that it seems to me quite correct to distinguish it as a representative of a special higher classificatory unit. Thus this form is characterized by a frontal organ of a type that is very different from other known species, by rudimentary lateral eyes (these are certainly represented by a pair of rather short, short-stalked, somewhat T-shaped appendages, fixed near the base of the first antenna; these appendages have been interpreted by C. CLAUS, curiously enough and certainly incorrectly, as gills (see 1873, p. 225); and G. W. MÜLLER (1890, p. 224) considered them to be remains of the gills of the primitive C y p r i d i n i d s!) and especially by the slight modification of the maxilla. Contrary to the maxilla in *Cypridina asymmetrica*, *C. Bairdi* and *C. favus*, but similar to the same organ in all the other representatives of the group *Cypridiniformes* hitherto known, the maxilla in *Monopia flaveola* has immoveable endites on the protopodite and an endopodite of fairly moderate length. On account of this limb this species may be said in a way to occupy an intermediate position between the three above-mentioned divergent forms and other species included in the genus *Cypridina* (sensu G. W. MÜLLERI).

For these reasons it seems to me best to retain both *Monopia* and *Cypridinodes*. I consider them, however, as sub-genera of the same genus, *Monopia*. — The former sub-genus is at present only represented by a single species, *M. flaveola*; in the latter are included *Cypridina asymmetrica*, *C. Bairdi* and *C.* (= *Cypridinodes*) *favus*; in addition, as is seen below, I have described another species of the latter sub-genus, *Monopia (Cypridinodes) acuminata*, a form that in its whole organization shows a very striking resemblance to the representative of this sub-genus described by G. W. MÜLLER. — With regard to the distinguishing characters of these two sub-genera I merely refer here to C. CLAUS, 1873 and to the diagnosis of the sub-genus *Cypridinodes* that is given later on in this work.

After the elimination of these divergent elements the genus *Cypridina* (sensu G. W. MÜLLER) may certainly be said to have become considerably more uniform. A further division of it appears, however, to be particularly desirable. The incompleteness and uncertainty of the diagnoses and figures of the majority of the remaining species are, however, so great that any attempt at the present moment to carry out a natural arrangement and division of all these forms must be considered premature and inconvenient.

A fairly large number of species belonging to this genus were found in the material that formed the basis of the present treatise. Because of this it seemed to me necessary, in spite of the difficulty of the task, to attempt even now to carry out a partial division of the genus in question. In doing this I have, of course, chiefly taken into account the forms that I myself have had occasion to investigate closely. I have tried, however, as far as possible, to show the relations of these forms to species that have been previously dealt with in the literature.

As a result of this attempt I have established four new sub-genera, as shown below; these sub-genera are:

Doloria
Vargula
Macrocypridina
Siphonostra.

The sub-genus *Vargula* is based on three species investigated by me but already described previously, namely *Cypridina norvegica* W. BAIRD, *C. antarctica* G. W. MÜLLER and *C. megalops* G. O. SARS. Besides these three species a large number of the forms included by G. W. MÜLLER under the name of *Cypridina* are probably to be referred to this sub-genus. That under these circumstances the name *Cypridina* has not been retained for these species, but that in the present work this name has been made to replace the entirely rejected generic name *Pyrocypris*, will be found explained below; see note under the sub-genus *Cypridina*. — *Macrocypridina* comprises only one species, *Cypridina castanea* established by G. S. BRADY, 1897. — The two remaining sub-genera, *Doloria* and *Siphonostra*, are based on species previously unknown to science. Whether any previously described species belongs to the sub-genus *Doloria*, I cannot say. To the sub-genus *Siphonostra* possibly belongs, besides *C.* (*S.*) *spinifera* described below, *Cypridina nobilis* P. T. CLEVE. With regard to the relationship of the last-mentioned sub-genus to *Cypridina hirsuta* G. W. MÜLLER and the extremely incompletely known genus *Heterodesmus* established by G. S. BRADY see below, note under the sub-genus *Siphonostra*. — With regard to the characters by which these sub-genera are distinguished I merely refer here to the diagnoses of these groups given below.

It is true, on the one hand, that all these four sub-genera are undoubtedly fairly closely related, but on the other hand they show such great differences from each other that it seems to me quite correct to distinguish them. I have had some doubt as to whether it is most convenient to denote these groups as genera or sub-genera. The relatively close relationship that exists between these groups in comparison with most of the previously established genera of this sub-family has induced me to put forward these new units as sub-genera. The question is, however, not a very important one. . . . .

This sub-family consequently comprises at the present moment in my opinion five natural recent genera altogether, one of them consisting of two and another of five sub-genera.

Genus *Crossophorus*		
„ *Codonocera*		
„ *Gigantocypris*		
„ *Cypridina*	Sub-genus	*Doloria*
	„	*Vargula*
	„	*Macrocypridina*
	„	*Cypridina*
	„	*Siphonostra*
„ *Monopia*	„	*Monopia*
	„	*Cypridinodes.*

Is it possible to establish the mutual relationships of these units? Are there any forms within this sub-family that can be indicated as being more primitive than the others? *The mutual relationships of the units.*

On account of the great uncertainty and incompleteness that, as I have pointed out above, distinguishes a great many of the descriptions of the forms belonging to this sub-family, it may perhaps seem too early to attack these difficult problems already. The result is destined a priori to be both meagre and uncertain. In spite of this I shall make an attempt in this direction on account of the importance of the enquiries. *Difficulties.*

To obtain an answer to these questions I have undertaken as detailed a comparison between these groups as is possible with the incomplete diagnoses at my disposal. In doing this as great a number of characters as possible have been taken into consideration. If I were to put forward here all the results arrived at during this work it would be a very comprehensive statement. It may, however, not be convenient to do so on account of the great incompleteness and uncertainty of the greater part of the diagnoses in question. Only the main results of this investigation will be given below.

Besides the incompleteness and uncertainty of the majority of the diagnoses of genera and species previously given, the difficulty in deciding the classificatory value of the different characters is an obstacle in determining the phylogenetic position of the various units. The question continually arises: is the resemblance the result of common inheritance or of convergence?

According to what I myself have observed, convergence appears to be by no means rare within this sub-family. In any case it is quite certain that it occurs, rather good evidence of it being found, as for instance in the furca.

The furca seems originally within this group to have been characterized by the fact that its claws were well defined from the lamellae and decreased uniformly in length the more proximally on the lamellae they were fixed. The fact that this furcal type prevails in all the families belonging to the sub-ordo *Cypridiniformes* supports this assumption. Within the sub-family *Cypridininae* we find a furca of this type in apparently all species of *Gigantocypris*, *Codonocera*, *Doloria*, *Macrocypridina*, *Monopia* and *Cypridinodes*. Within the sub-genera *Cypridina* (sensu meo), *Vargula* and *Siphonostra* we find, however, other furcal types as well. In the first of these three sub-genera the following furcal types may be distinguished:

Type I: All the furcal claws are well defined from the lamellae and decrease uniformly in length and strength the more proximally they are situated. — This type is found in *C. (C.) acuminata* (G. W. MÜLLER) and *C. (C.) natans* (G. S. BRADY). Cf. G. W. MÜLLER, 1906 b, pl. II, fig. 3.

Type II: The second furcal claw is united with the lamella, the others are all well defined proximally; all the claws decrease uniformly in length and strength the more proximally they are situated, sometimes, perhaps, the third of them is somewhat weaker than one would expect from its position. — This type is found in *C. (C.) dentata* (G. W. MÜLLER), *C. (C.) inermis* (G. W. MÜLLER) and *C. (C.) sinuosa* (G. W. MÜLLER). Cf. G. W. MÜLLER, 1906 b, pl. II., figs. 21, 10 and 11.

Type III: The second furcal claw is united to the lamella, all the others are well defined proximally; all the claws decrease fairly uniformly in length and strength the more proximally they are situated, with the exception of the third, which is considerably shorter and weaker than one would expect from its position. — This type is found in *C. (C.) amphiacantha* (G. W. MÜLLER). Cf. this author, 1906 b, pl. III., fig. 11.

Type IV: The second and fourth furcal claws are united to the lamella, all the others are well defined proximally; all the claws decrease uniformly in length and strength the more proximally they are situated, with the exception of claw no. 3, which is considerably shorter and weaker than one would expect from its position. — This type is found in the females of *C. (C.) serrata* (G. W. MÜLLER) [= *C. (C.) lepidophora* (G. W. MÜLLER), cf. below, note on *C. (C.) serrata*, var. *affirmans*]. Cf. G. W. MÜLLER, 1906 b, pl. III., fig. 19.

These types are found in the sub-genera *Vargula* and *Siphonostra* as follows:

Type I: Appears to occur in most of the species of the sub-genus *Vargula*, as for instance in *C. (V.) megalops*; see the fig. 16 of this organ of this species in this work.

Type II: Found in *Cypridina Hilgendorfi* G. W. MÜLLER, a species that is certainly to be referred to the sub-genus *Vargula*. See G. W. MÜLLER, 1890, pl. XXVI., fig. 1.

Type III: Found in *Cypridina Vanhöffeni* G. W. MÜLLER, a species that certainly belongs to the sub-genus *Vargula*. Cf. G. W. MÜLLER, 1908, pl. V., fig. 4.

Type IV: Found in the female of *Cypridina (Vargula) norvegica* (W. BAIRD); the third furcal claw is, however, only rather slightly weakened; cf. the description of this species given below. In addition we find this furcal type in the only representative of the sub-genus *Siphonostra*. The resemblance between G. W. MÜLLER's drawing of the furca for *Cypridina (C.) serrata*, ♀, and the figure given below in this work of the furca in *Cypridina (Siphonostra) spinifera* is really almost perfect.

The occurrence of the second, third and fourth furcal types in these three sub-genera can certainly not be explained otherwise than by convergence. One can as a matter of fact scarcely avoid the idea that in these groups there is to be found a „tendency" in the second and fourth furcal claws to unite with the lamella and in the third furcal claw to be reduced in length and strength!

Other examples of convergence within this sub-family could be given, but the one given above, which is the most striking, should, at least in this connection, be sufficient.

Important characters. Among all the characters I have had occasion to observe those which seemed to me the most noteworthy for the solution of this problem were the equipment on the b-

and c-bristles of the male first antenna and the development of the endopodite of the second antenna in the male.

With regard to the b- and c-bristles on the first antenna of the male one might say with fairly great certainty that originally in the sub-ordo *Cypridiniformes* they were not provided with suctorial organs for seizing the female. For in this group an equipment of this kind has so far been observed only in the sub-family *Cypridininae*; in all the representatives known so far of the sub-family *Philomedinae* and of the families *Rutidermatidae*, *Sarsiellidae* and *Asteropidae* such organs are, on the contrary, entirely lacking.

With regard to the other of the two characters mentioned one might say with equally great certainty that the endopodite of the male second antenna in the *Cypridiniformes* was originally developed as a more or less powerful, three-jointed clasping arm used for seizing the female. As early as 1890 (p. 218) G. W. MÜLLER expressed this view. This assumption is supported by the occurence of an endopodite modified in this way both in the sub-families *Cypridininae* and *Philomedinae* and in the family *Asteropidae*. In the family *Sarsiellidae* traces of such a development can still be verified. In the family *Rutidermatidae* males are unknown.

Classification according to these characters.

A classification of the genera belonging to the sub-family discussed here according to these two characters shows the following result:

The b- and c-bristles with suckers.	The b- and c-bristles have proximally a rather short and powerful branch, furnished at about the middle with a rather large and powerful sucker; distally of this one or two rather long and powerful branches are found, which have distally one or usually a row of very small suckers all of about the same size.	*Cypridinodes* *Cypridina* (sensu str. et meo) *Macrocypridina* *Vargula*	The endopodite of the male second antenna is not developed as a clasping organ.
		Doloria	The endopodite of the male second antenna developed as a powerful clasping organ.
	The b- and c-bristles with a powerful rather long branch, furnished distally with a number of suckers of moderate size, all arranged in an umbel.	*Codonocera*	
	The b- and c-bristles with one or more rather short branches all with a rather powerful sucker in the middle.	*Gigantocypris*	
The b- and c-bristles without any suckers.		*Crossophorus*	

No males of the sub-genera *Monopia* and *Siphonostra* are known so far; on account of this these two units could not be included in the above table.

As is seen from this table the genus *Crossophorus* is decidedly opposed to all the other units included in the table, as its male first antenna is quite without suctorial organs on the b- and c-bristles. Whether this absence of suckers is primary or not is, of course, a question impossible to decide with certainty at present; it seems, however, fairly probable to me that it is primary. With regard to the endopodite of the male second antenna this genus is primitive. In a number of other characters as well *Crossophorus* seems to have retained a certain primitiveness, for instance with regard to the endites of the mandible (cf. p. 171 above). It seems to me rather probable that this genus is to be considered as being in several respects the most primitive one in this sub-family.

A close comparison fully confirms the fact that there is a contrast between *Crossophorus* and the other genera belonging to this sub-family, almost all the organs in the former genus showing a more or less divergent type, for instance first and second antennae, the mandible, the seventh limb, and the furca. As a matter of fact there can be no doubt that this genus occupies a rather isolated position in this sub-family. It might be most convenient to set this genus up as a representative of a special group within this sub-family, in contrast systematically with all the other genera, or perhaps even to distinguish it as a sub-family, *Crossophorinae*, i. e. as a group equivalent systematically to *Cypridininae* and *Philomedinae.*

For the relation of the genus *Crossophorus* to the last-mentioned sub-family see above, p. 178.

All the other units of the sub-family *Cypridininae* mentioned above seem to me to be the result of a not very extensive variation in different directions of one and the same fundamental type.

According to the table given above these units may be divided into three group as follows:

I. *Gigantocypris*

II. *Codonocera*

III. *Doloria*, *Vargula*, *Macrocypridina*, *Cypridina* (s. str. et meo) and *Cypridinodes*.

This classification, although based exclusively on the equipment of the b- and c-bristles on the male first antenna, seems also to represent the mutual phyletic position of these units. For a close investigation of the general organization of these forms seems to give the result, partly that *Gigantocypris* and *Codonocera* are mutually rather different, partly that each of these two genera presents a certain contrast to the five sub-genera included in the third group. Whether *Gigantocypris* or *Codonocera* is to be considered as more closely related to the five sub-genera in question seems to be difficult to decide at present. Probably, however, *Gigantocypris* represents the type that differs most from these.

The sub-genera *Doloria*, *Vargula*, *Macrocypridina*, *Cypridina* and *Cypridinodes* are certainly closely related to one another. They are also closely related to *Monopia* and *Siphonostra*, the two sub-genera that are not included in the table given above. To show conclusively their natual mutual relations is an exceedingly difficult — if not quite impossible — task. I only wish to make the following statements:

As has been pointed out above, *Monopia* seems in a way to occupy a classificatory position intermediate between *Vargula* and *Cypridinodes*, the last-mentioned of which is the most aberrant type of these units. In spite of this, as is seen above, I have considered it most convenient to distinguish the first-mentioned and the last-mentioned of these three units from all the others as two sub-genera of a specific genus *Monopia*. — It may be mentioned in passing that C. CLAUS, 1873, p. 223 put forward the assumption that *Monopia flaveola* might be rather closely related to J. D. DANA's species *Cypridina punctata* (J. D. DANA, 1852, pl. 91, fig. 2).

The sub-genus *Doloria*, on account of the primitive type of the endopodite of its male second antenna, seems to occupy a certain exceptional position not only to *Vargula*, *Macrocypridina*, *Cypridina* (s. str., s. meo) and *Siphonostra*, but also to *Monopia* and *Cypridinodes*. It seems to me rather probable that it separated from the others before the differentiation of *Monopia-Cypridinodes*. In spite of this I have deemed it proper to join it to the four first-mentioned of these units on account of the great agreement that it shows with these in all the other characters; as is pointed out above, they are all in this treatise classified as sub-genera of one and the same genus *Cypridina*.

The result of this investigation, which — as has been pointed out above — merely on account of the uncertainty and incompleteness of the material can by no means be considered as certain, may be shown graphically in something like the following manner, fig. XXV.

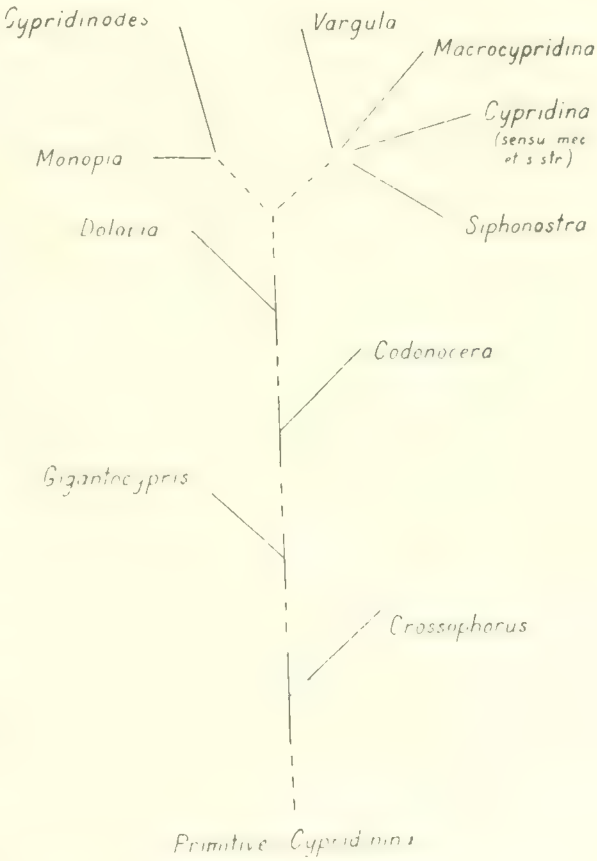

Fig. XXV. The hypothetical pedigree of the sub-family *Cypridininae*.

With regard to the mutual relations of the different species within the genera it is, of course, even more difficult to make any statement. — Even in those genera in which the majority of the species have been described by G. W. MÜLLER, undoubtedly our foremost Ostracod investigator, our knowledge of the species is rather limited on account of the deficiencies of the diagnoses. In the present work I have accordingly almost entirely refrained from drawing conclusions on this point.

Position of the species.

Oecology of reproduction: — With regard to the phenomena of the oecology of reproduction in this sub-family nothing or practically nothing certain is known, nor can I contribute much towards the solution of this problem.

Only in the case of two species belonging to this sub-family, *Cypridina (Doloria) pectinata* and *Cypridina (Vargula) norvegica* have I had an opportunity of investigating specimens captured at different periods of the year. I found that sexually mature females with embryos in the brood chamber and also larvae in different stages of these two genera appeared at all the periods at which specimens were captured. It seems accordingly probable that these two species do not have any definite more or less short pairing period but that propagation in their cases takes place during the whole year. The same thing seems to apply to the other species belonging to this sub-family (as in all other Cypridiniforms?)

It is uncertain whether the fertilization takes place during a pairing flight similar to that observed in the case of *Philomedes (Ph.) globosa*. All we know for certainty is that benthoic species of this sub-family have also sometimes been observed in plankton; we find information — though it is scanty — about this in the literature.

The males seem, at least in some species, to survive for rather a long time after attaining sexual maturity. There is, as we know, no reduction of the masticatory limbs as in *Philomedes* and *Sarsiella*. A species of this kind is *Cypridina (Vargula) norvegica*; the males and females of this species were found equally numerous during all times of the year. — On the other hand, in the samples of *Cypridina (Doloria) pectinata* investigated by me sexually mature males were very rare. During the last larval stage this sex was, however, found to be somewhat more numerous than the female sex (proportion about 5 : 4). Do the males die comparatively soon after the fertilization of the females in this species?

Genus Gigantocypris G. W. Müller.

Gigantocypris, autorum.

Description: — Cf. G. W. Müller, 1895, p. 164.

Shell: — More or less globular. With small but proportionately rather deep and narrow rostral incisur; the bristles within the incisur variable. Posteriorly close to the hinge the edges of the valves are separated, by means of which a small, somewhat rounded opening is formed. The valves united along about 2/3 of the periphery. The adductor weakly developed. Balloon-shaped; walls very thin, presumably without lime incrustation. Very large forms.

First antenna: — Long, slender, with 7—8 joints; for the proportion between the joints see the species description below. The third joint relatively long. The sensory bristle of the fifth joint has a moderate, somewhat varying, number of filaments, rather more numerous in the males than in the females. On the bristles b and c one or more of the proximal rami in the male are modified for seizing the female. These rami, all of which are placed medially, are all of about the same type, rather short and powerful, somewhat swollen proximally, moderately chitinized distally, most often ending with a short hair; a little proximally to half

their length they have a single, large, powerful suctorial disc. The c-, f- and g-bristles are considerably longer in the male than in the female; the b-bristle but slightly lengthened in the former.

Second antenna: — The protopodite has a medial-distal bristle. Exopodite: The bristle of the second joint rather powerfully developed, unarmed. The natatory bristles on the third to ninth joints entirely without spines. The last-mentioned joints with or without basal spines. The endopodite developed in the males into a powerful clasping organ with three joints. Besides the proximal-ventral bristle its end-joint has two short distal bristles placed close together. In the females the endopodite is also comparatively well developed, extended, with three joints; the bristle of its end joint very long.

Mandible: — Protopodite: The endite of the coxale is weakly bifurcated distally; some of its spines are rather powerful, those on the medial and also some of those on the lateral side arranged in very distinct groups. Apart from the bristle of the endite there are no bristles on the coxale joint. Basale: Of the ventral bristles one d-bristle is very long, furnished with numerous long secondary bristles and short-haired distally; the rest of these bristles are of moderate length or short, most of them furnished only with short hairs. On the dorsal side this joint has three bristles. Endopodite: The first joint has four bristles ventrally. The anterior side of the second joint is very richly furnished with bristles. The end joint armed with seven bristles, of which the medial of the two middle ones is longer than the others and claw-shaped.

Maxilla: — Protopodite: The coxale has dorso-distally a single long-fine-haired bristle. Proximally on the outside of the third masticatory process there is a single bristle. At the boundary between the basale and the first endopodite joint there are in most cases three bristles, one close to the exopodite, one at about the middle of the inside of the endopodite and one at the anterior margin of the latter. The coxale has dorso-distally a rather large, leaf-shaped epipodial appendage. The exopodite is comparatively well developed, with thick, long fine hairs; not displaced distally. The endopodite is broad and moderately long.

Sixth limb: — The second exopodite joint rather short; somewhat rounded, and furnished with numerous bristles; the posterior-distal ones of the latter do not dominate the others at all strikingly.

Seventh limb: — Fitted with very numerous cleaning bristles; a large number of these are placed close together near the point of the limb, the rest spread irregularly along the distal part of the limb; as to the position of the last-mentioned bristles it is to be noticed that most often there is only one bristle on the same side of one and the same joint, two bristles are, however, not infrequently found close to each other on the same joint. The end comb consists of a very large number of teeth of moderate strength, all of about the same type and size. Dorsally close to the end comb the wall of this limb is not at all or only slightly thickened, forming merely a slight depression. There is no special muscle for compressing the latter.

Furca: — The lamellae are short. The number of claws is about 10—15, without any clear division into main and secondary claws.

The upper lip has no large processes. Most of the glands open out on a median ridge, running dorso-ventrally on the anterior side; the glandular field is thus quite without the distinct triple division that is characteristic of most genera of this sub-family. There is a low protuberance on the front between the upper lip and the frontal organ.

The median eye is exceedingly large and strikingly metamorphosed.

The rod-shaped organ is almost or quite rudimentary.

The lateral eyes are very much reduced.

Remarks: — So far only two species of this genus, which is so peculiar in its habitus, have been dealt with in the literature, viz. *G. Agassizi* and *G. pellucida*. Both these forms were caught at the same time during the cruise of S. S. „Albatross" along the west coast of Central America in 1891 and were described by G. W. MÜLLER, 1895. Five specimens of the first-named species were found by this expedition, of which four were females and one male; of the other species only one specimen was captured, a male not mature sexually, which, according to G. W. MÜLLER's supposition, was „vor der zur Geschlechtsreife führenden Häutung" (p. 165).

With regard to *G. pellucida* this author writes on pp. 164 and 165 of the recently quoted work: „Schale, Gliedmaaßen und sonstiger Körperbau wie bei *Agassizii*; am Putzfuß war die Zahl der Zähne in der Reihe an der Spitze viel kleiner (7 anstatt etwa 60; Tafel 1, Fig. 16, 15). Neben den typischen Borsten (Tafel 1, Fig. 23), existiren solche mit einfachem pinselartigem Ende (Fig. 22), letztere sind viel seltner als die erstgenannten. In der Magenwand fehlen die Muskelfasern, an ihrer Stelle finden sich nur dünne, anscheinend nicht contractile Fasern, entsprechend ist der Darm an conservirtem Material nicht contrahirt; ferner fehlen die zur Leibeswand verlaufenden Bindegewebsfasern. Das untersuchte Thier . . . . maß 16 mm."

G. H. FOWLER writes in 1909, p. 257, concerning the relationship of these two species to each other: „I regard it, however, as possible that *pellucida* is the penultimate stage of *agassizii*". No reason at all for this assumption is produced, however, by this writer.

About at the same time this assumption was also put forward by L. LÜDERS in his essay „*Gigantocypris Agassizii* (MÜLLER)", p. 144. This author pointed out that the cleaning limb in young animals of this genus is only weakly developed. He then added: „Dies dürfte auf die Ausbildung seiner Zähnchen und Borsten nicht ohne Einfluß gewesen sein." With regard to the histological differences between the two forms put forward by G. W. MÜLLER L. LÜDERS wrote (loc. cit.): „Ferner sollen in der Magenwand die Muskelfasern fehlen und sich nur dünne, nicht contractile Fasern befinden. Dieser Nachweis ist aber bekanntlich sehr schwierig. Wir können uns hier auf mehrere Autoren berufen . . . . MÜLLER dürfte seinen Schluß auch mehr aus dem Umstande gefolgert haben, daß der Darm zufällig nicht kontrahiert war. Jedenfalls können wir diese Fasern als „scharf unterscheidendes Merkmal" nicht gelten lassen. Endlich sollen noch die zur Leibeswand verlaufenden Bindegewebsfasern fehlen. Dies wäre allerdings ein sehr ins Gewicht fallendes Merkmal und verdiente wohl in erster Linie genannt zu werden. Dadurch würde sich die *G. pellucida* aber von sämtlichen Cypridiniden unterscheiden, von denen, soweit bekannt, auch nicht einer einzigen diese Bindegewebsfasern fehlen. Nachdem wir ferner die große Bedeutung dieses Bindegewebes für den Blutkreislauf der *G. Agassizii*

kennen gelernt haben, und es endlich unerklärbar bleibt, wie der Mitteldarm in der Leibeshöhle suspendiert ist, fällt es schwer, diesen Mangel des Bindegewebes als tatsächlich bestehend anzunehmen. Ich möchte deshalb auch hier einen Irrtum nicht für ausgeschlossen halten.“

The correctness of the assumption that *G. pellucida* is a larva of *G. Agassizi* may be considered as pretty certain. Besides the reasons quoted above from L. LÜDERS the following evidence in favour of this assumption may be advanced here:

Except *G. Agassizi* no form is yet known which can possibly be considered as the sexually mature stage of *G. pellucida.*

The two forms were captured at the same time and at the same locality.

In examining 11—12 mm. long larvae of my Atlantic species of this genus described below I have stated that their seventh limb was characterized by the same small number — about 15—20, i. e. about 7—10 on each side — of teeth of the end comb as this appendage of *G. pellucida.* The number of the bells on the cleaning bristles of this limb was less than in the sexually mature stage, none of these bristles was, however, quite without bells. It is, however, noteworthy that cleaning bristles quite of the type that G. W. MÜLLER found in a very small number on this limb of *G. pellucida,* in other words bristles „mit einfachem pinselartigem Ende“ (G. W. MÜLLER, 1895, Pl. I. fig. 22), were found in *G. Mülleri,* also very seldom, both on sexually mature specimens and on larvae. This type had, however, obviously arisen by the distal part of the bristle having been broken off, the simple „pinsel“-shaped point represented simply the proximal bell of the intact bristle.

Whether *G. pellucida* corresponds to the first or second larval stage of *G. Agassizi* seems, on the other hand, very difficult to decide. Its small length, 16 mm., compared with the 21—23 mm. of the sexually mature specimens, certainly seems to support the idea that it represents the second larval stage, contrary to G. H. FOWLER's assumption.

G. W. MÜLLER in his above-mentioned work (p. 165) put forward the assumption that a representative of the genus *Gigantocypris* had already before been mentioned in literature. In a letter to CARL von SIEBOLD RICHARD von WILLEMOES-SUHM wrote that the „Challenger“ Expedition had caught an Ostracod with a shell of 25 mm. length between Prince Edward's and Crozet Islands (R. v. WILLEMOES-SUHM: „Briefe v. d. Challenger-expedition.“ Zs. wiss. Zool. Bd. XXIV, p. XIII. Leipzig. 1874). G. W. MÜLLER also made the same assumption in one of his later works, 1906 a, p. 136. A later author, L. LÜDERS, 1909, p. 103, repeats this assumption.

[illegible] *„Challenger“?*

According to a statement of W. T. CALMAN in a notice in Nature, vol. LXXX. 1909, p. 248 the specimen to which WILLEMOES-SUHM referred is still preserved in the British Museum. It is not, however, an Ostracod, but a species belonging to *Leptostraca, Nebaliopsis typica,* described by G. O. SARS.

Gigantocypris Mülleri n. sp.

? *Gigantocypris pellucida*. G. H. FOWLER, 1909, pp. 257, 296.
„ „ TH. SCOTT, 1912 b, p. 5, pl. II, figs. 1—12.

Description: — Female:

Shell: — Length 14—17 mm. The specimens from S/S „Michael Sars“ and M/S „Armauer Hansen“ attained a length of 14—16 mm.; the specimens from S/S „Antarctic“ 16,5—17 mm. It is almost globular, with about the following proportions: — length : height : breadth = 16,5 : 15 : 14. Seen from the side (fig. 1) it is almost perfectly circular, with the posterior part somewhat larger than the anterior; the ventral side is somewhat flattened. The rostrum small, somewhat convex anteriorly, sometimes a little more than is shown in the adjoining figure, pointed ventrally. The posterior opening of the shell, seen from the side, is sometimes not marked, sometimes more marked than in the adjoining figure. Seen from beneath (fig. 2) it is also almost circular, with the posterior part dominating somewhat over the anterior; sometimes a little more rounded at the back than is shown in the adjoining figure. Seen from the front it is almost circular. The surface of the shell is smooth, without any sculpture or hair. The pores of the surface are very small and difficult to verify with certainty. Seen from within (fig. 19): Medial bristles: On the rostrum there are very numerous, moderately long, simple, smooth, rather powerful bristles; on the specimens from S/S „Michael Sars“ and M/S Armauer Hansen“ about 75—125 were observed, on the specimens from S/S „Antarctic“ about 125—175 (on the adjoining figure, drawn from an „Antarctic“ specimen, all the bristles are, for practical reasons, not shown). Near the point of the rostrum these bristles are arranged in irregular rows running within one another; sometimes they are, however, almost entirely without any arrangement; dorsally these bristles continue in a single row running near the border of the shell almost to the junction between the two valves. Near the inner edge of the incisur there is only one or a few short simple bristles, which vary in their position. Along the ventral edge of the incisur there are only a few bristles or no bristles at all. Along the anterior half of the ventral border of the shell on or near the list there is a somewhat varying number of bristles, most of them of the same type as the rostral bristles, a few short and weak; posteriorly these bristles become more and more sparse and at the same time shorter and weaker, but medial bristles may be observed along the whole ventral edge of the shell; the number of these bristles is, as already stated, somewhat varying; on the average, however, there is the same number along the whole ventral edge of the shell as on the rostrum. The joined part of the lamellae along the edge of the shell is very narrow, which is probably connected with the balloon-like swelling of the shell. The selvage is moderately broad, about the same width along the whole edge of the shell, with fine cross-striation, and finely serrated at the edge (fig. 5).

First antenna: — This is rather elongated; the anterior side of the second to the eighth joint measured, for instance, 4 mm. on a specimen with a length of shell of 14,5 mm.;

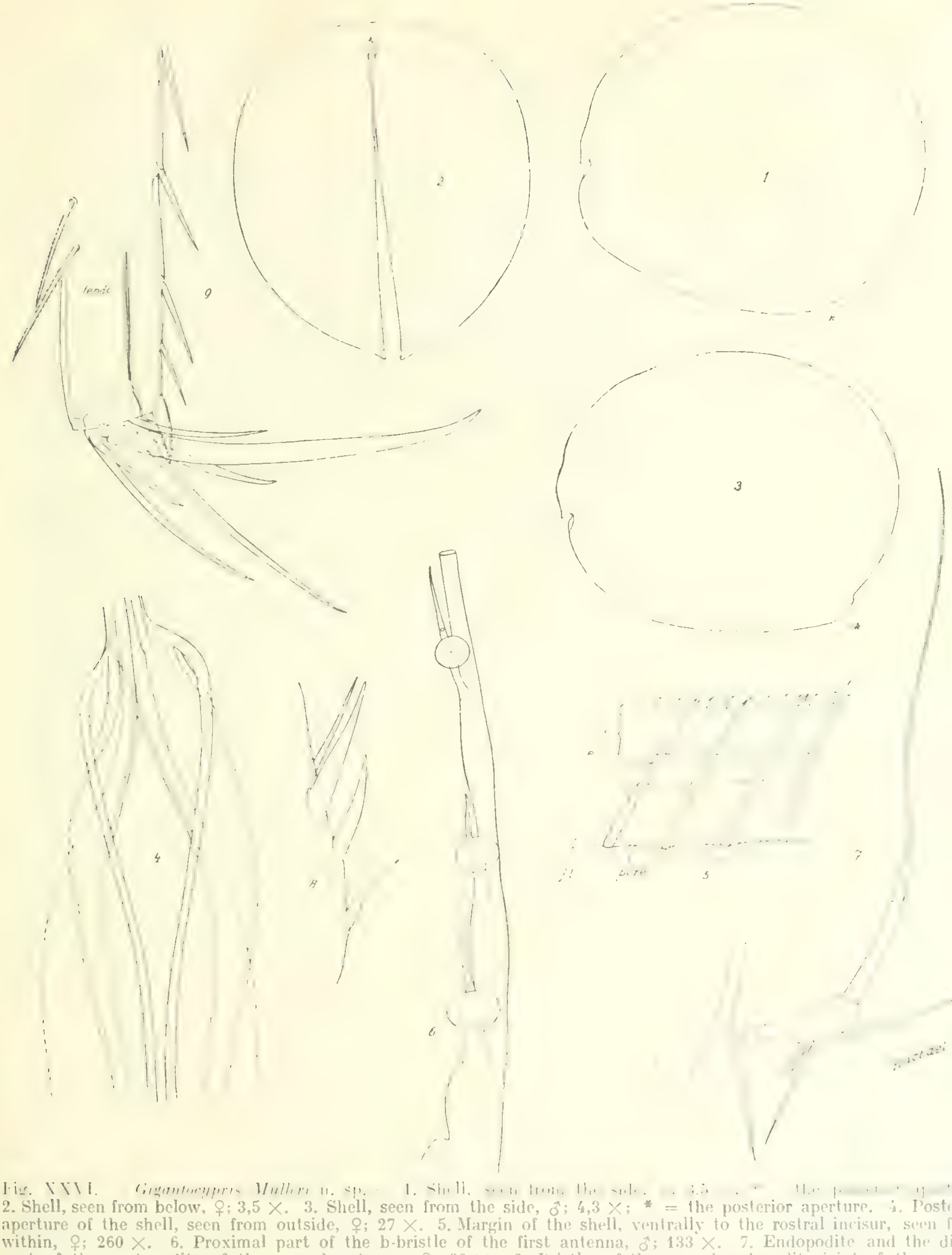

Fig. XXVI. *Gigantocypris Mülleri* n. sp. 1. Shell, seen from the side, ♀; 3,5 ×; * = the posterior aperture. 2. Shell, seen from below, ♀; 3,5 ×. 3. Shell, seen from the side, ♂; 4,3 ×; * = the posterior aperture. 4. Posterior aperture of the shell, seen from outside, ♀; 27 ×. 5. Margin of the shell, ventrally to the rostral incisur, seen from within, ♀; 260 ×. 6. Proximal part of the b-bristle of the first antenna, ♂; 133 ×. 7. Endopodite and the distal part of the protopodite of the second antenna, ♀; 30 ×. 8. Bristles of the second endopodite joint of the second antenna, ♂; 133 ×. 9. Distal part of the endopodite of the right mandible, seen from inside, ♀; 88 ×. (Figs. 1, 2 and 5 from a specimen from station 70, b, Antarctic Exp. 1901—03; figs. 4,7 and 9 from a specimen from station 82 of S/S „Michael Sars"; figs. 3, 6 and 8 from a specimen from station [illegible] of M/S „Armauer Hansen".

eight-jointed. The proportion between the joints shows some, though rather insignificant variation; is about as follows:

I [illegible]; II [illegible]; III [illegible]; IV [illegible]; V [illegible]; VI [illegible]; VII [illegible]; VIII 0,5;

in other words about the same as in pl. II., fig. 5, TH. SCOTT, 1912 b. The end joint is often somewhat withdrawn into the seventh joint and rather difficult to verify with certainty; it is best seen from the lateral side; it is moved by special muscles. The anterior bristle of the third joint is situated somewhat proximally of the middle of the joint. This bristle, the posterior bristle of this joint, the two bristles of the fourth joint, the bristle of the sixth joint, and the a bristle of the seventh joint are most frequently subequal or rather slightly different from each other in length, about as long as the third joint; the length varies, however, to some extent; all these bristles are bare or have short hairs. The sensory bristle of the fifth joint is rather long, attaining to about the length of the posterior side of the second to the eighth or the third to the eighth joint. The b-bristle about as long as the anterior side of the third and fourth joints. The c-bristle attains about the same length as the whole antenna. The d- and e-bristles are in most cases somewhat different in length from each other and somewhat shorter or longer than the b-bristle. The g-bristle attains about half the length of the shell, the f-bristle is somewhat shorter. The number of filaments on the sensory bristle of the fifth joint and on the distal bristles varies somewhat, as is shown in the table below. The lengths in this table are the averages of the right and left first antenna; in most cases, however, the right and left bristles were quite the same length; the difference was never great.

		Sensorial bristle of the 5th. joint.		b-bristle.		c-bristle.		f-bristle.		g-bristle.	
		Number of filaments	Length mm.	Number of filaments	Length mm.	Number of filaments	Length mm.	Number of filaments	Length mm.	Number of filaments	Length. mm.
„Michael Sars"	Right	14	3,2	4	1,7	20	5,4	22	5,8	23	7,0
Type specimen	Left.	14		5		21		21		23	
„Michael Sars"	Right	14	3,0	5	1,7	24	5,5	25	6,0	27	7,3
1st. specimen	Left	14		5		24		23		26	
„Michael Sars"	Right.	14	3,2	5	1,6	23	5,6	23	5,7	25	7,0
2nd. specimen	Left.	14		4		24		21		23	
„Michael Sars"	Right.	13	3,3	5	1,7	23	5,8	26	6,2	27	7.5
3rd. specimen	Left	14		5		22		25		27	
„Armauer Hansen"	Right	14	3.0	5	1,5	23	5,2	24	5,7	[illegible]	6.9
1st. specimen	Left.	13		5		22		25		25	
„Antarctic"	Right	14	3,9	5	2,2	27	6,7	33	7,4	33	8,7
1st. specimen	Left.	15		5		25		33		32	
„Antarctic"	Right	15	4,0	5	2,3	28	7,1	33	7,3	36	8,9
2nd. specimen	Left	14		5		27		31		[illegible]	

The filaments on the sensorial bristle of the fifth joint are rather long, their length varying to some extent, the longest being about a quarter of the whole length of the bristle; the distal one is rather short; they are all narrow, cylindrical, naked; between the short distal filament and the next distal one there is a decided gap, which does not exist between the others. The

filaments on the distal bristles are either bare or furnished with some few short, weak secondary spines. Pilosity: The whole antenna is hairless or at any rate has only extremely sparse and very short hairs.

Second antenna: Protopodite: The medial-distal bristle is relatively long, attaining to about the same length as that of the longest bristle in the proximal group of bristles on the first joint of the endopodite (fig. 7). Exopodite: This is rather long; yet it is comparatively somewhat shorter than the exopodite of other species of this sub-family that are dealt with in this treatise; by way of comparison the following figures may be given: the length of the shell: the length of the exopodite is about 4 : 1 in this species, 3.5 : 1 in *Cypridina (Vargula) norvegica*, 3 : 1 in *C. (V.) megalops*, and 3.3 : 1 in *Cypridina (Macrocypridina) castanea*. The proportion between the length of its first joint and the united length of all the following joints is about 3 : 2; the second joint is about as long as the total length of the third and fourth joints. The bristle of the second joint is about as long as the total length of the third to the ninth joints or somewhat longer; distally it is bifurcated, cf. the adjoining figure 20. The length of the longest natatory bristles: the length of the whole exopodite is about 5 : 3. The end joint has four natatory bristles; the dorsal one, which is the shortest, is about the same length as the whole of the exopodite. All the natatory bristles are fitted with well-developed and rather broad natatory hairs along almost their whole length. The third to the ninth joints have rather weak basal spines (these are, however, stronger than those reproduced for *Cypridina (Macrocypridina) castanea*, fig. 11 of this species). The third to the eighth joints are in most cases furnished laterally-distally with sparsely placed weak spines; medially-distally, on the other hand, they have none of these. Endopodite (fig. 7): This is very long and narrow; the second joint is about twice as long as the first and third joints. The first joint has a group of four bristles proximally, one of which is rather long, about as long as the second joint or somewhat shorter; the other three are subequal, not quite attaining to half the length of the former; in addition on this joint, somewhat distally of this group of bristles, there is a single bristle, about as long as or somewhat longer than the longest proximal one; all these bristles are bare or have extremely fine short hairs. The second joint has a short bristle distally, $^1/_2$ to $^1/_5$ the length of the end joint. The bristle of the end joint is considerably longer than the endopodite, in some specimens even extending somewhat behind the posterior boundary of the protopodite.

Mandible: — The type is about the same as that shown in pl. II, fig. 7, Th. Scott, 1912 b. — Protopodite: The endite of the coxale is of about the same type as that shown in pl. I, fig. 20, G. W. Müller, 1895; it has very numerous spines, is weakly bifurcated distally, the two distal points are somewhat more powerful than the spines and, unlike the latter, armed with rather powerful secondary spines; between the two distal points there is a low process (cf. p. 182 above). The basale has ventrally three short a-bristles, somewhat different in length, furnished with short hairs or spines; in front of the most anterior of these bristles there is an extremely short almost peg-like bristle; in front of this, with almost the same situation and proportions as in Th. Scott's figure mentioned above, there are one b-bristle, two c- and two d-bristles; the b-bristle was missing on one mandible in the specimen from M. S. „Armauer

Hansen". The relative length of these bristles varies somewhat, however. The b-bristle is short haired; both the c-bristles usually have short hairs, on the right mandible of the specimen from M/S „Armauer Hansen" the longest of them was, however, fitted with long secondary bristles in the middle; the shorter d-bristle also usually has long secondary bristles in the middle, often, however rather few in number, in the second specimen from S/S „Antarctic" it was even short-haired. The three dorsal bristles are subequal, about as long as or somewhat shorter than the dorsal side of this joint; they have short hairs or are almost bare, the proximal one is fixed somewhat distally of half the length of the joint. — The exopodite is somewhat longer than the dorsal side of the first endopodite joint. Of its two bristles the proximal one is about as long as the dorsal bristles of the second protopodite joint, the distal one attains to only about half the length of the exopodite; both have short hairs or are almost naked. - Endopodite: The four ventral bristles of the first joint have a comparative length that is typical for this sub-family; the longest one does not quite attain to the length of the posterior side of the second endopodite joint, furnished with irregular wreaths of long secondary bristles, with short hairs distally, the other three are short-haired. The second joint: This has a thick mass of bristles of various kinds along almost the whole anterior side. The number and situation of the bristles seem to vary rather considerably; firstly there are 20—30 more or less long bristles with sparse short hairs, about the same as in TH. SCOTT's figure mentioned above, secondly a very large number of cleaning bristles, either arranged in more or less distinct rows running slantingly upwards and forwards, or at least partly almost quite without regular arrangement; the number of these rows of bristles is difficult to decide with certainty, as they are situated very close together, yet it seems to vary between fifteen and a little over twenty. The posterior bristles in these rows are rather short, the distal two thirds of them are finely pectinated, about the same type as shown in fig. 21 adjoining; the pectination on these bristles is so fine that it can only be observed with difficulty with REICHERT's ok. 4, LEITZ' immers. $\frac{1}{12}$. In front of these bristles, thus nearer the anterior edge of the joint, the cleaning bristles are somewhat longer and of somewhat different types; a number of them have extremely fine pectination on their distal half or third; a number are very powerfully pectinated on their distal third or quarter; the stalk of these bristles is often furnished with a more or less large number of rather powerful spines proximally of the pectinated part (the types shown in figs. 22 and 23); spines may also occur on the stalk of the short cleaning bristles. Transitional forms between these different cleaning bristles are, however, to be observed. On the distal half of the posterior side of this joint there are three to five rather short, almost subequal, moderately strong, naked bristles (fig. 9), situated at about an equal distance from each other. Distally of these there are two spine-shaped bristles, situated next to each other, most frequently somewhat shorter than the former but very much stronger, in most cases about as long and as strong as each other; sometimes the medial one is shorter, though rather slightly so. Of the seven bristles of the little end joint (fig. 9) the medial of the two middle ones is comparatively long and powerful, varying somewhat in its comparative length, most frequently about as long as half the posterior side of the second endopodite joint or somewhat shorter; the other of the two middle bristles is somewhat weaker and only about half the length of the former

one or somewhat shorter. Of the two anterior ones, both rather weak, the lateral one is about half, the medial one about a quarter of the length of the main claw. Of the three posterior ones, all rather weak, one is somewhat shorter than the main claw, one about half the length of the former, and the third, as usual in this sub-family, almost completely reduced. All the bristles of the end joint are quite smooth. Pilosity: The second protopodite joint has numerous groups of short, stiff, fine hairs; the other joints have only sparse hairs or are quite smooth.

Maxilla: — Protopodite: The first endite has twelve powerful, subequal bristles of moderate length, all furnished with a number of wreaths of long, stiff secondary bristles. About half these bristles have distally a moderate number of secondary teeth, usually rather coarse, and a simple and powerful point; the remainder, in most cases somewhat weaker than the former ones, are strongly pectinated distally right out to the points, so that they appear more or less strikingly three-pointed distally. In a few cases thirteen bristles were observed on this process. The second endite (fig. 11) has seven distal bristles, all rather powerful, of moderate length, subequal except for the fifth and sixth, reckoning from outside, which are most frequently somewhat shorter than the rest. They all have a somewhat varying number of wreaths of long, stiff secondary bristles; distally of these secondary bristles bristle no. 5 has only a few secondary teeth, no. 6 is rather finely pectinated distally and the rest are more or less coarsely pectinated distally. The third endite (fig. 12) has nine or ten distal bristles, all furnished with a more or less large number of irregular wreaths of long, stiff secondary bristles. Three to four of the most distally situated of these bristles are considerably shorter than the rest and are usually furnished distally with only a few secondary teeth; the others are of moderate length, subequal — the outer one being, however, somewhat longer than the rest — and distally they are either rather finely pectinated like the two outer ones and the innermost one or else coarsely pectinated. The proximal bristle on this endite is sparsely furnished with short hairs and is about as long as the outside of this process. The bristle situated distally of the epipodial appendage is about as long as the first endopodite joint. Of the three bristles on the boundary between the basale and the first endopodite joint the one situated near the exopodite is of about the same length and type as the two distal bristles on the exopodite, the two others are short, about half as long as the first endopodite joint or somewhat shorter, and have short hairs or are quite naked. In one case two bristles were observed instead of one on the anterior edge of the endopodite. Exopodite: The two distal bristles are usually subequal and somewhat longer than the exopodite; the remaining bristle is about half the length of the former ones; they all have long, stiff secondary bristles and distally they have short hairs. On one of the „Antarctic“ specimens (the other specimen brought home by this expedition was defective with regard to this character) one of the two distal bristles had short hairs. Endopodite: First joint: Distally (fig. 10) this has four (in one case on one maxilla there were only three, in another case five) anterior and four posterior bristles. The former are moderately long and strong, in most cases diminishing somewhat in length according as they are situated more posteriorly; all are sparsely furnished with short hairs. The four posterior ones decrease rather rapidly in length and strength according as they are situated more anteriorly; they are all sparsely but coarsely

pectinated, the two anterior ones have only a few secondary teeth. The posterior edge of this joint is irregularly undulated distally, forming a low cutting process. The end joint (fig. 10): This is moderately chitinized. Usually it has six (in a single case seven) a-bristles of moderate strength and length, naked or with sparse, weak secondary teeth; this joint has, in addition, four b-bristles, four or five, in most cases five, c-bristles and three d-bristles. The b-bristles are most frequently subequal, of moderate length and strength, the anterior one of them sparsely but strongly pectinated, the rest usually only with a few secondary teeth in the middle. The c-bristles are often placed somewhat irregularly, some of them about as long and strong as the b-bristles, the others rather short and weak; the longer ones among them have rather powerful but sparse secondary teeth, on the shorter ones the secondary teeth are fewer and weaker and may even be quite absent. The d-bristles are somewhat longer than the b-bristles and very powerful, especially the two anterior ones; they are armed with sparse, coarse secondary teeth, the anterior ones most frequently with only a few of these. Pilosity: The epipodial plate of the protopodite is partly furnished with fine hairs. The first endopodite joint has anteriorly-distally groups of fine short hairs.

Fifth limb: — Protopodite: The first endite (fig. 15) has in most cases fourteen bristles; in one case among the specimens from S. S. „Michael Sars" only thirteen were observed, while the specimens from S. S. „Antarctic" had fourteen or fifteen bristles on this process. Of these bristles the inner-anterior one is rather short, almost bare or furnished with one wreath or a few wreaths of long secondary bristles. The rest are moderately or rather long, their relative length somewhat varying, in most cases being about what is shown in the adjoining figure; they are all rather powerful and have a varying, in most cases rather large number of wreaths of long, stiff secondary bristles; most of them are fitted distally with a varying number of rather powerful secondary teeth, some are bare distally. The five inner bristles of the second endite (fig. 16) are rather powerful, subequal, of moderate length, all with a number of wreaths of long, stiff secondary bristles, the middle one of them finely serrated, the rest with rather coarse secondary teeth distally, generally somewhat fewer and coarser on the two posterior bristles than on the two anterior ones. The bristle a little farther out on the anterior side of this process is short, bare or almost bare. Third endite: (fig. 17) All seven bristles are of moderate length, subequal except nos. 5 and 6, reckoning from the front, which are somewhat shorter than the rest; the five anterior ones are rather powerful, the two posterior, especially the most posterior, very powerful. The two anterior ones are of the same type as each other, fitted with several wreaths of long, stiff secondary bristles in the middle and rather coarsely pectinated distally; the three middle ones are generally without long secondary bristles, two of them are finely serrated, the third coarsely pectinated distally; the two posterior ones have several wreaths or cross-rows of long, stiff secondary bristles in the middle, distally they are somewhat bent and armed with a somewhat varying number of secondary teeth, of which the proximal ones are very powerful. The epipodial plate has about seventy to eighty marginal bristles; on the ventral ones of these the distal third or quarter is naked or has short hairs, on those situated more dorsally the long hairs extend still farther out towards the point of the bristles; on all of them, however, the point itself is quite naked. The structure

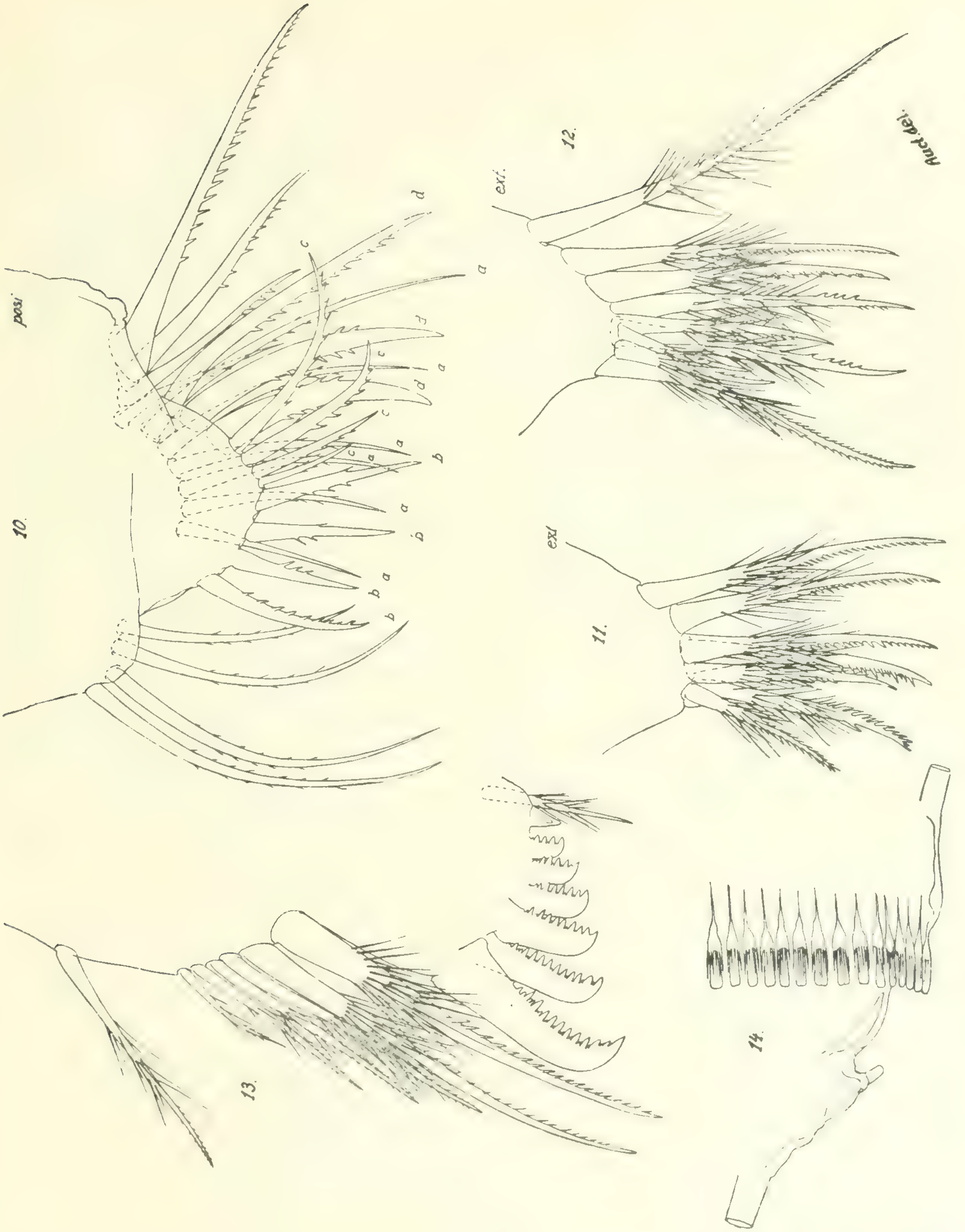

Fig. XXVII. — *Gigantocypris Mülleri* n. sp. — 10. Distal part of the endopodite of the right maxilla, seen from within, ♀; 62 ×. 11. Second endite of the maxilla, ♀; 62 ×. 12. Third endite of the maxilla, ♀; 62 ×. 13. First exopodite joint of the fifth limb with the main tooth, ♀; 86 ×. 14. Distal part of the seventh limb; the proximal teeth of the end comb are not drawn, ♀; 480 ×. (From a specimen from station 82 of S/S „Michael Sars").

of the distal part of these bristles does not, however, justify the assumption of an adaptation for sensory function. The distal chitinous process of the protopodite is rather powerful, bent and of moderate length. The exopodite is five-jointed. The first joint (fig. 13): The main tooth has seven constituent teeth all well defined proximally; the secondary teeth on the latter appear about as in the adjoining figure, alternately powerful and very weak, sometimes, however, several weak ones between two strong ones. The bristle close to the main tooth, on the posterior side of the joint, is about as long as the longest constituent tooth of the former, moderately strong and with long, stiff secondary bristles in the middle, almost bare distally. On the anterior side of this joint close to the main tooth there is a series of six bristles; the two situated closest to the main tooth are subequal, rather long and strong, the rest decrease fairly uniformly and rapidly in length and strength the farther they are situated from the main tooth; the shortest one is only about a quarter of the length of the two longest. They all have long, stiff secondary bristles in the middle; these secondary bristles become, however, fewer as the bristles become shorter. The bristle situated nearest to the main tooth is rather strongly pectinated distally; the distal equipment decreases on the others as the length of the bristles decreases, the shortest ones being almost bare distally. A little way in front of these bristles on the anterior side of this joint there is a single bristle of about the same type and length as bristle no. 3 among the last-mentioned six bristles, counting from the main tooth; in one case among the specimens from S S „Michael Sars" two such bristles were observed at this place. The second joint (fig. 18): This has five, in exceptional cases six, a-bristles, nine b-bristles, one c- and one d-bristle. The a- and b-bristles are rather powerful, with numerous rather strong secondary teeth. The c- and d-bristles are of moderate length, with long, stiff secondary bristles in the middle, distally almost bare or with short hairs. Third joint: The inner process is small and has three bristles, two moderately long and subequal distal ones, with short hairs or almost bare, and a proximal-posterior one which is short and has most frequently long secondary bristles in the middle and short hairs or else is quite bare distally. The outer process of this joint is somewhat greater than the inner one and has two moderately long, subequal, rather powerful distal bristles, both of them with long secondary bristles in the middle and with short hairs or almost bare distally. The fourth exopodite joint is rather large. Distally it has ten to thirteen moderately long and powerful bristles somewhat different in length from each other, arranged in two parallel rows; in the posterior row there are four or five bristles somewhat shorter, on the average, than those in the anterior one, with short and rather powerful secondary bristles; in the anterior row there are five to eight bristles; most frequently all of them are almost bare, except the outer one, which in most cases has long, stiff secondary bristles in the middle. The end joint is small but well defined, and is moved by a special muscle. It has two subequal bristles, whose type and length is about the same as the two bristles on the outer process of the third exopodite joint. Pilosity: The outer process of the third joint of the exopodite and the fourth and fifth joint of this branch are partly furnished with fine hairs.

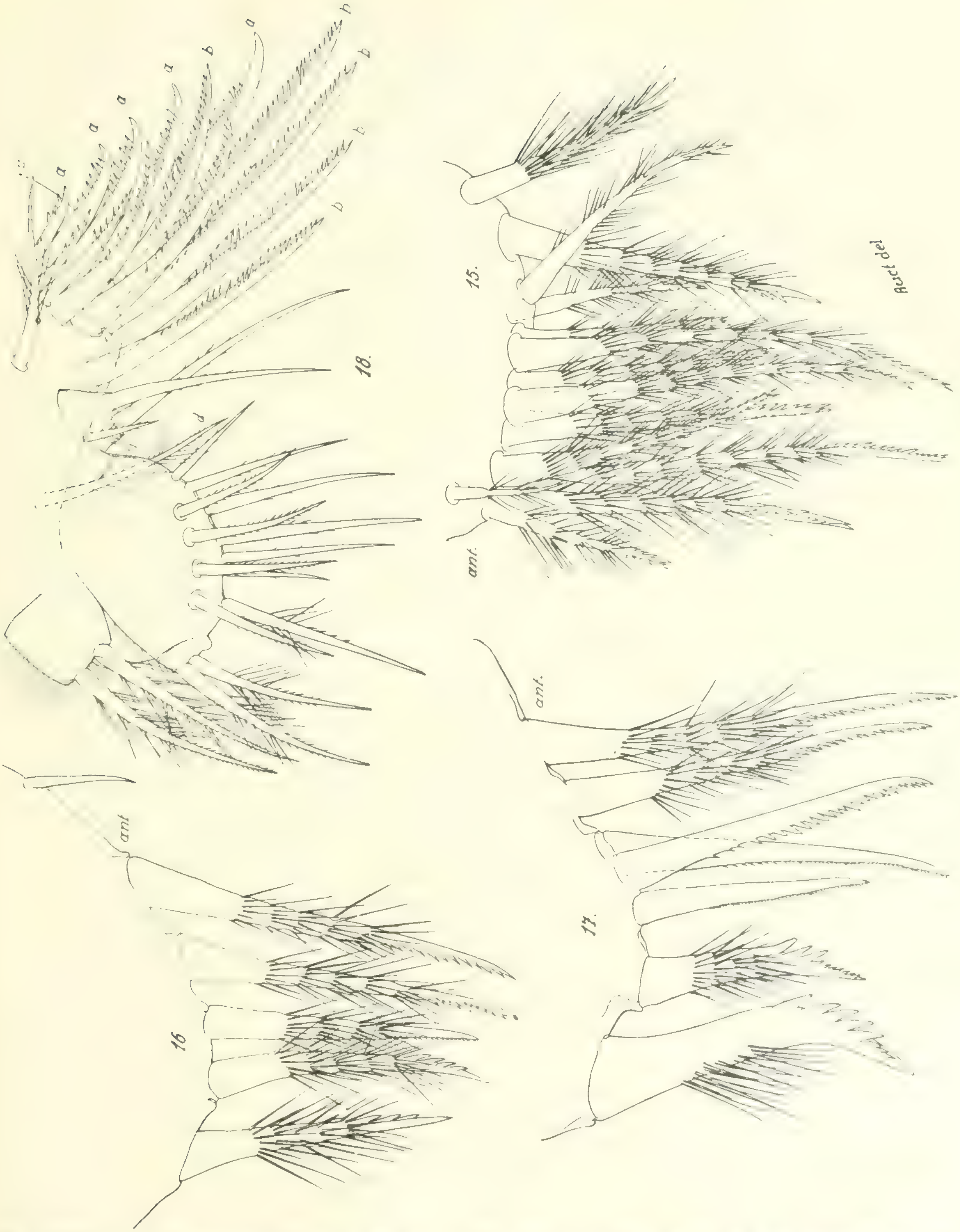

Fig. XXVIII. — *Gigantocypris Mulleri* n. sp., ♀. — Fifth limb: 15. First endite of the protopodite; 105 ×. 16. Second endite of the protopodite, 105 ×. 17. Third endite of the protopodite; 105 ×. 18. The four distal joints of the left exopodite, seen from behind; 62 ×. (From a specimen captured at station 82 of S/S „Michael Sars").

Sixth limb: — As will be seen from the following table the number of the bristles of this limb varied a little: (d = distal bristle, m = medial bristle).

		1st endite of the protopodite	2nd endite of the protopodite	3rd endite of the protopodite	Epipodial lamina	Endite of the 1st joint of the exopodite	2nd. joint of the exopodite
„Michael Sars"	Right.	2 d + 2 m	4 d + 3 m	6 d + 1 m	6	11 d + 2 m	29
Type specimen	Left.	2 d + 2 m	5 d + 3 m	7 d + 2 m	6	11 d + 2 m	28
„Michael Sars"	Right.	2 d + 2 m	5 d + 3 m	8 d + 2 m	6	12 d + 2 m	34
1st. specimen	Left.	2 d + 2 m	5 d + 3 m	8 d + 2 m	6	12 d + 2 m	36
„Michael Sars"	Right.	2 d + 2 m	5 d + 3 m	8 d + 2 m	7	11 d + 2 m	42
2nd. specimen	Left.	2 d + 2 m	6 d + 3 m	8 d + 2 m	7	12 d + 3 m	40
„Michael Sars"	Right.	2 d + 2 m	5 d + 3 m	8 d + 2 m	7	13 d + 2 m	39
3rd. specimen	Left.	2 d + 2 m	5 d + 3 m	8 d + 3 m	4	13 d + 2 m	37
„Armauer Hansen"	Right.	2 d + 2 m	5 d + 2 m	7 d + 2 m	5	11 d + 3 m	33
1st. specimen	Left.	2 d + 2 m	5 d + 2 m	7 d + 1 m	3	10 d + 3 m	34
„Antarctic"	Right.	2 d + 2 m	5 d + 3 m	8 d + 1 m	4	13 d + 2 m	57
1st. specimen	Left.	2 d + 2 m	5 d + 2 m	8 d + 2 m	5	14 d + 3 m	55
„Antarctic"	Right.	2 d + 2 m	5 d + 3 m	8 d + 2 m	6	12 d + 3 m	45
2nd. specimen	Left.	2 d + 2 m	5 d + 3 m	8 d + 2 m	8	11 d + 2 m	42

Protopodite: First endite: The distal bristles are of moderate length and strength, subequal, furnished with a number of wreaths of long, stiff secondary bristles extending right to the points of the bristles; the medial bristles are short and have long hairs. Second endite: This has one distal bristle rather considerably shorter than others, but rather strong, with long secondary bristles in the middle, and with short hairs or almost bare distally; the other distal bristles are of moderate length and strength and subequal; they all have several wreaths of long, stiff secondary bristles and are pectinated or almost smooth distally. The medial bristles are short and have long hairs. Third endite: One of the distal bristles is somewhat shorter than the others, very powerful, and has a few wreaths of long, stiff secondary bristles in the middle and a few very powerful secondary teeth distally. The other distal bristles are of moderate length and strength and subequal; one of the dorsal ones is, however, in most cases somewhat shorter and weaker than the others; either all of them have long, stiff secondary bristles in the middle or one or more may be without them; they are pectinated or bare distally. The medial bristles are of about the same length as the distal ones or somewhat shorter; they have a few wreaths of long, stiff secondary bristles and are pectinated or bare distally. The bristles of the epipodial appendage are short, with short hairs or bare; in only one case was one of these bristles found to have long and soft hairs. Exopodite: Endite of the first joint: The distal and medial bristles are of about the same length and type as the bristles on the third endite of the protopodite; one (in one case two were observed) is somewhat shorter than most of the others, but it is very powerful, it has some wreaths of long, stiff secondary bristles in the middle and is furnished distally with a few powerful secondary teeth; two, situated laterally, one ventrally, the other at about half the height of the endite, were considerably shorter and weaker than the rest and had short hairs; in one case only one of them, the ventral one, was found on the limb of the one side, the other was missing. The bristles of the second exopodite joint are all situated near the ventral edge and there is no pronounced gap between the posterior

ones and the rest. They are somewhat different from each other in length and strength, most of them being moderately long and strong, some of those situated more anteriorly rather short and weak. Some of these bristles, especially the short ones, are furnished only with short, stiff secondary bristles, the others have wreaths of long, stiff secondary bristles in the middle and short ones distally; the wreaths of secondary bristles are rather few on the anterior bristles, more numerous on the posterior ones. The two or three posterior bristles — whose long secondary bristles are of the same type as on the other bristles, stiff and arranged in wreaths — are bare or have rather fine short hairs distally. Pilosity: The inner side and the ventral part of the outer side of the second exopodite joint have numerous groups of short, stiff, fine hairs.

Seventh limb: — This is unusually long; we may mention that on two specimens, one with a shell 15 mm. long, the other 14 mm. this appendage attained a length of 22 mm. and 20 mm. respectively. The distal $1/7$ of the limb is armed with bristles. The position and relative length of the bristles is about as is shown in pl. II, fig. 11, TH. SCOTT, 1912 b, but we have, however, to notice that whereas in this figure — presumably owing to a mistake — of the proximal scattered cleaning bristles two are never fixed on the same side of one and the same joint, in my specimens such a duplication is by no means uncommon. The number of the cleaning bristles varies from about 90 to about 130—140 on each side, the numbers being, however, very difficult to determine with certainty on account of the closeness of the bristles to each other distally on the limb. The bristles (fig. 24) are armed distally with 1—10 bells which are most frequently distally cut obliquely; the tongue of the distal bell is also cut somewhat obliquely; the presence of so few bells as one or two is, however, very rare. Proximally of the bells the cleaning bristles are smooth. The end-comb (fig. 14) has about 90—150 teeth, all of about the same type, i. e. fairly square distally and with a series of bristle-like secondary teeth running across the middle. Dorsally between the end comb and the cleaning bristles there is an unpaired and rather small and smooth chitinous peg (fig. 14).

Furca: — This is of the same type as that shown in pl. II, fig. 12, TH. SCOTT, 1912 b. The number of claws varies somewhat; the specimens from S/S „Michael Sars“ had eleven to thirteen (the type specimen eleven); the specimen from M/S „Armauer Hansen“ had ten; of the specimens from S/S „Antarctic“ one had eleven + twelve, the other not less than fourteen + fifteen claws. Behind the claws the furca is bare.

Upper lip and median eye: — These seem to correspond exactly to these organs in *G. Agassizi.* The lateral eyes are very greatly reduced, and certainly do not function as organs of sight.

The number of embryos in the specimens from S/S „Michael Sars“ and M/S „Armauer Hansen“ was about thirty to fifty; in the specimens from S/S „Antarctic“ there were 57—85. Several of the females with their embryos far developed had rather large eggs in the ovaries, about twenty to twenty-five in each ovary.

Male: —

Shell: — Length 12—13 mm.; length : height : breadth about 12,5 : 10 : 9, i. e. the height is comparatively a little less than in the females. The posterior aperture of the shell

Fig. XXIX. — *Gigantocypris Mülleri* n. sp. — 19. Anterior part of the right valve, seen from within; all the medial bristles of the rostrum are not drawn, ♀; 33 ×. 20. Distal part of the bristle on the second exopodite joint of the second antenna, ♀; 500 ×. 21, 22 and 23. Different types of cleaning bristles on the second endopodite joint of the mandible, ♀; 233 ×. 24. Distal part of a cleaning bristle of the seventh limb, ♀; 325 ×. 25. Penis, drawn as if it were semi-transparent; all the bristles are not drawn; 93 ×. — The female specimen from station 70, b of the „Antarctic", the male from the station 88 of the „Michael Sars".

is more strongly marked than in the case of the female, but not always so strongly as shown in the adjoining figure 3. Otherwise it agrees pretty well with that of the female.

First antenna: — This is somewhat more elongated than in the female; thus, for instance, the anterior side of the second to eighth joint attained a length of 4.4 mm. on a specimen with a shell 12 mm. long; the second joint seems to be somewhat shorter, comparatively,

than in the female. The number of filaments on the sensory bristle of the fifth joint and on the distal bristles seems to vary somewhat, as appears from the following table: (The lengths are the averages of right and left first antennae; in most cases, however, the right and left bristles were almost exactly of the same length; the difference was never great.)

		Sensorial bristle of the 5th. joint.		b-bristle.		c-bristle.		f-bristle.		g-bristle.	
		Number of filaments	Length mm.	Number of filaments	Length mm.	Number of filaments	Length mm.	Number of filaments	Length mm.	Number of filaments	Length mm.
„Michael Sars“	Right.	19	3.8	5	2.3	34	12.7	42	12.5	44	12.5
1st. specimen	Left.	19		5		36		47		50	
„Michael Sars“	Right.	25	4.0	5	2.3	36	13.0	55	12.5	53	12,5
2nd. specimen	Left.	25		5		37		55		51	
„Armauer Hansen“	Right.	19	3.7	5		36	13.0	42	13.0	46	13.5
1st. specimen	Left.	22		?		37		?		49	

On a defective specimen from S/S „Michael Sars“ the sensory bristle of the fifth joint had twenty filaments on both antennae, one f-bristle had 46 and one g-bristle 47 filaments. The filaments on the sensory bristle of the fifth joint are comparatively longer than those of the female, most of them are somewhat spool-shaped, though only slightly so. B-bristle (fig. 6): The three proximal filaments are metamorphosed for seizing the female; distally of the sucker these three filaments have one or a few chitinous verruciform swellings; the two distal filaments are of the same type as in the female. C-bristle: The proximal filament is metamorphosed for seizing the female, it is of the same type as the three proximal filaments on the b-bristle; on the right antenna of the specimen from M/S „Armauer Hansen“ the second filament, counting from the base, also had a suctorial organ; this suctorial organ, fixed to the base of the filament, was of a somewhat pathological type; as in other respects the filament was of about the same type as the more distally situated filaments, this case is probably to be considered an abnormality. The c-, f- and g-bristles are, as shown in the above table, subequal and of about the same length as the shell. In other respect this limb agrees with that of the female.

Second antenna: — The protopodite is slightly more powerful than in the female; in one specimen with a shell 12.5 mm. long it attained a length of 4,0 mm.; while in a female with a shell 14,5 mm. long it only measured 3,5 mm. The endopodite is almost exactly of the same type as in *G. Agassizi*, as this is shown in pl. I, fig. 19, G. W. MÜLLER, 1895. The bristles of the first joint, all situated proximally on the joint, are quite like the female's. The second joint has four short, subequal, bare bristles (cf. the accompanying figure 8); no less than two of the four males investigated were obviously pathological in this character. The ventral bristle of the end joint is fixed about half-way along the joint and attains about the same length as the second joint or is sometimes even somewhat longer.

Penis: — This has the fundamental type usual for this sub-family. For details the reader is referred to the accompanying drawing no. 25; not quite all the bristles are shown in this.

The other organs agree very well with those of the female; in one case I found on the first exopodite joint of the fifth limb only five, not six, bristles in the row next to the main tooth.

Remarks: — As is seen from the description given above, this species is distinguished, contrary to most other forms of this sub-family that are dealt with in this treatise, by the fact that several organs, especially the first antenna and the sixth and seventh limbs, are subject to a not inconsiderable variation. In spite of this it seems to be very probable that we are dealing with a single classificatory unit. In any case the striking continuity shown by the variation, in spite of the limited material, supports this view.

How is this form related to G. W. MÜLLER's previously described Pacific species of this genus?

G. W. MÜLLER's description of *G. Agassizi* (1895) is rather incomplete. In spite of that I believe that one may say with pretty great certainty that the Atlantic form described above by me is a new species, well differentiated from *G. Agassizi*, which was in reality already to be assumed a priori on account of the fact that the two forms were caught in two districts fairly well separated from a zoological point of view.

The characters in which *G. Agassizi* is differentiated from the Atlantic species are as follows:

The length of the shell is greater (G. W. MÜLLER, [1895] gives 23 mm., 1912 only 21 mm.).

First antenna: This has only seven joints. „Das letzte Glied, an dem sich Reste einer Verschmelzung aus 7 und 8 nicht nachweisen lassen . . . .“ In the male the five proximal filaments on the b-bristle and the two proximal filaments on the c-bristle are modified for seizing the female.

Second antenna: The exopodite has no basal spines on the third to the ninth joints; the second joint on the female endopodite has no bristles; the bristle of the end joint of the last-mentioned branch does not attain the length of the endopodite.

The seventh limb has more than 200 cleaning bristles on each side.

In all these characters the Atlantic form seems to be more primitive than the Pacific form. — To judge from G. W. MÜLLER's drawings the two forms seem to be differentiated in still more characters. The superficiality of the drawings makes it rather probable, however, that these differences are due, at least in part, to lack of exactitude on the part of the author; on account of this I have thought it best not to discuss these characters at any length here.

Synonymy. In a later work (1906 b) G. W. MÜLLER mentions (p. 135) that about ten, mostly young, specimens of this genus — „Alle gehören, soweit ich das feststellen konnte, zu *Gigantocypris Agassizii*“ — were caught by S/S „V a l d i v i a“* between lat. 14° N. and lat. 42° S. in the Atlantic and Indian Oceans. Only two pictures of habitus were given. Whether any of these finds are to be referred to my above described species it is impossible to decide. It may, however, be pointed out that fig. 5, pl. V shows a type of shell so different from the one that is characteristic of my species that an assumption of this sort seems anything but probable. — It may be stated in passing that this figure also suggests most decidedly that G. W. MÜLLER's identification with *G. Agassizi* is incorrect.

It is true that the material of the „V a l d i v i a“ expedition was subjected later on to a renewed investigation by L. LÜDERS (1909), but this author's drawings of the limbs, etc.

* See also C. CHUN, 1900, p. 515.

are so extremely bad, so incomplete and incorrect that, unfortunately, the classificatory position of these specimens cannot be decided from this work either. It is, however, to be noted that the drawing of the shell given by this author shows a type that approaches considerably more the one which is characteristic of my above described species. The exopodite of the second antenna appears to be without basal spines; p. 108.

Without giving any detailed information about the type or the species, J. RICHARD mentions (1900, p. 83) that a *Gigantocypris* 1 cm. long was caught at a depth of 1732 metres off the Azores, thus in the neighbourhood of stations 51, 53 and 62 of S/S „Michael Sars". — In this author's work of 1904 a specimen of this genus is also mentioned from Atlantic (p. 15).

G. H. FOWLER mentions that two specimens of this genus were caught by S/S „Research" in 1900 in the Bay of Biscay (1909, p. 257). There are no detailed descriptions. „By size they belonged to MÜLLER's species *pellucida*; the perfect specimen measured about 13 mm."

Similarly *G. Agassizi* is mentioned in G. W. MÜLLER's work of 1908, p. 87; no figures or descriptions are given.

Whether these finds are to be referred to *G. Mülleri* it is impossible at present to decide with absolute certainty. As is seen above I have written FOWLER's form as synonymous to this species, although it seemed to me best to add a query.

There can of course scarcely be any doubt that the species *Gigantocypris pellucida* described by TH. SCOTT, 1912 b, p. 5 from lat. 58° 43′ N., long. 9° 6′ W. — thus in the neighbourhood of S/S „Michael Sars's" stations nos. 98 and 101 — is identical with *G. Mülleri*. Small differences are to be noted in some characters; for these I need only refer to TH. SCOTT's and my figures. The explanation of these differences lies probably, however, chiefly in lack of accuracy on the part of TH. SCOTT.

All the larvae investigated by me were females, in either the last or the penultimate larval stage; the number of furcal claws was nine or ten. *Larvae.*

This form is named after G. W. MÜLLER, who is incomparably our greatest expert on the Ostracod group and the investigator through whom the first representative of this genus, so peculiar in its habitus, was made known to science. *Name.*

Habitat: — This species was captured at the following localities in the Atlantic and the Antarctic Oceans:

By S/S „Michael Sars" during the „North Atlantic Deep Sea Expedition", 1910 at the following stations: (All catches made with open nets).

Stat. 23.	Lat.	35° 32′ N.,	long.	7° 7′ W.	5—6/V.	1 juv.	
„ 29.	„	35° 10′ „	„	7° 55′ „	9—10/V.	2000 m. of wire out.:	1 juv.
„ 49B.	„	29° 8′ „	„	25° 16′ „	1/VI.	3000 „ „ „ „	1 mature
„ 51.	„	31° 20′ „	„	35° 7′ „	5—6/VI.	300 „ „ „ „	1 juv.
„ 53.	„	34° 59′ „	„	33° 1′ „	8—9/VI.	1600 „ „ „ „	4 „
„ 53.	„	34° 59′ „	„	33° 1′ „	8—9/VI.	2100 „ „ „ „	1 mature

Stat. 53. Lat. 34° 59′ N., long., 33° 1′ W. 8—9/VI. 2600 m. of wire out.: 1 mature ♀,
1 mature ♂, 2 juv.
,, 62. ,, 36° 52′ ,, ,, 39° 55′ ,, 20—21/VI. 2500 ,, ,, ,, ,, 2 juv.
,, 62. ,, 36° 52′ ,, ,, 39° 55′ ,, 20—21/VI. 3000 ,, ,, ,, ,, 1 ,,
,, 82. ,, 48° 24′ ,, ,, 36° 53′ ,, 13/VII. 1500 ,, ,, ,, ,, 1 mature ♀
(type locality)
,, 82. ,, 48° 24′ ,, ,, 36° 53′ ,, 13/VII. 2000 ,, ,, ,, ,, 1 mature ♂
,, 84. ,, 48° 4′ ,, ,, 32° 25′ ,, 15/VII. 2500 ,, ,, ,, ,, 1 ,,
,, 87. ,, 46° 48′ ,, ,, 27° 46′ ,, 17/VII. 1500 ,, ,, ,, ,, 1 ,, ♂, 1 juv.
,, 88. ,, 45° 26′ ,, ,, 25° 45′ ,, 18/VII. 1500 ,, ,, ,, ,, 2 juv.
,, 88. ,, 45° 26′ ,, ,, 25° 45′ ,, 18/VII. 2000 ,, ,, ,, ,, 1 mature ♀,
1 ,, ♂, 1 juv.
,, 90. ,, 46° 58′ ,, ,, 19° 6′ ,, 21/VII. 1500 ,, ,, ,, ,, 1 juv.
,, 90. ,, 46° 58′ ,, ,, 19° 6′ ,, 21/VII. 2000 ,, ,, ,, ,, 1 mature ♀, 2 juv.
,, 92. ,, 48° 29′ ,, ,, 13° 55′ ,, 23—24/VII. 1000 ,, ,, ,, ,, 1 ,, ♀
,, 92. ,, 48° 29′ ,, ,, 13° 55′ ,, 23—24/VII. 1500 ,, ,, ,, ,, 1 juv.
,, 94. ,, 50° 13′ ,, ,, 11° 23′ ,, 26/VII. 2000 ,, ,, ,, ,, 1 mature ♀, 2 juv.
,, 98. ,, 56° 33′ ,, ,, 9° 30′ ,, 5/VIII. 1500 ,, ,, ,, ,, 1 ,,
,, 101. ,, 57° 41′ ,, ,, 11° 48′ ,, 6—7/VIII. 1500 ,, ,, ,, ,, 1 juv.
,, 101. ,, 57° 41′ ,, ,, 11° 48′ ,, 6—7/VIII. 2000 ,, ,, ,, ,, 1 ,,

It is to be pointed out that most of these stations are within the region of the Gulf Stream.

By M/S „Armauer Hansen" during the summer cruise of 1910:

Stat. 9. Lat. 54° 51′ N., long. 28° 15′ W., 17—18/VII., 1300 m. of wire out.: 1 mature ♂
,, 14. ,, 59° 30′ ,, ,, 20° 40′ ,, 25/VII., 1300 ,, ,, ,, ,, 1 ,, ♀.

The catches were made with open nets.

By S/S „Antarctic" during the South Polar Expedition, 1901—1903:

Station 70. b. Lat. 49° 56′ S., long. 49° 56′ W., 27/VI. 1902; depth 2700—0 m.; temp. + 1,67° and + 3,36° C resp.: 1 mature ♀.

Station 77. b. Lat. 62° 1′ S., long. 53° 57′ W., 12/XII. 1902; depth 700—0 m.: 1 mature ♀.

This species thus appears to be found in the Atlantic and the Antarctic Oceans in a region extending from about 60° N. lat. to 60° S. lat.

With regard to the depth at which it is found it is to be noted that the specimens caught by G. H. FOWLER with a closing net were at a depth of between 1350 and 1800 metres and between 2700 and 3600 metres. — „The two captures of this species give the first definitive evidence that it is a deep-water form", p. 296 — and that the one captured by S/S „Michael Sars" was found at so slight a depth as 150 metres (Station no. 51; „300 metres of wire out" is probably to be reduced to the above number).

With regard to the specimens brought home by the „Valdivia" Expedition G. W. MÜLLER writes in 1906 a (p. 136): „Die Färbung* (vergl. Taf. V. Fig. 4, 5)" — red —

* Cf. C. Chun, 1900.

„spricht für eine Tiefseeform; leider gestatten die Fänge keinen sicheren Schluß auf die Tiefe des Vorkommens, da es sich durchweg um Vertikalfänge des offenen Netzes handelt. Am wenigsten tief reicht von den „Valdivia"-Fängen 55 V b (1200 m.), der „Albatross" erbeutete Vertreter sogar aus nur 100 Faden (185 m.), so daß die Form, wenn sie, wie ich vermute, ein Bewohner großer Tiefen ist, sicher gelegentlich zu geringeren Tiefen aufsteigt."

This assumption seems also to apply to *G. Mülleri*. This species too is probably to be considered as being a form that lives mainly in deep water and that, like many other pelagian forms, undertakes migrations up to lesser depths.

The specimens of S/S „Michael Sars" and M/S „Armauer Hansen" are stored in B. Z. M., those of the „Antarctic" (on slides) in R. M. S.

Gigantocypris Mülleri n. sp. var. minor n. var.

In one of the samples of plankton from S/S „Michael Sars" were found two sexually mature females of this genus, which, although they bore a rather great resemblance to the species described above, differed from it so essentially in so many respects that it seemed to me best, as a preliminary, to distinguish them as a special form. This form has been arranged as a variety under the above-mentioned species and has not been set up as a new species especially for two reasons, partly because the preceding species appeared to be not inconsiderably variable and partly because one of the two specimens in question resembled this species considerably more than the other in several respects. It is not impossible that we are dealing with specimens of the above-mentioned species whose development has been checked by unfavourable conditions. The answer to this question can only, however, be obtained after renewed investigations, carried out with more abundant material.

To enable the reader to decide how far the two specimens resembled or were different from the type species it seemed most convenient in the description to call one specimen (the most divergent) the a-specimen and the other the b-specimen.

Description: — Female: —

Shell: — Length: Specimen a attained a length of 9 mm., specimen b 10 mm. The shape was about the same as that of the type species, but somewhat less globular, however; proportion of length : height : width about 10 : 8 : 7, thus somewhat lower than the type species. The medial bristles were considerably fewer than in the type species, but varied very much in number; on the rostrum of specimen a about 45 bristles were found (cf. fig. XXX, on which all the bristles are drawn), on the rostrum of specimen b about 60; on the list behind the incisur about 40—60 bristles were found on the former specimen, about 40—50 on the latter. Otherwise there was agreement with the type species.

First antenna: — The proportion between the joints is about the same as in the type species; the second joint is, however, somewhat longer comparatively; the third joint, on the other hand, is somewhat shorter comparatively. The anterior bristle of the third joint is fixed at about the middle of the joint (in specimen a) or just proximally of this. All the

bristles have about the same length in relation to the antenna as in the type species. The distal e-, f- and g-bristles have considerably fewer filaments and the sensory bristle of the fifth joint has also somewhat fewer filaments, as is shown in the following table. (The lengths given are the averages of right and left first antennae; often, however, the right and left bristles were quite equal in length; the difference was never great.)

		Sensorial bristle of the 5th. joint.		b-bristle.		e-bristle.		f-bristle.		g-bristle.	
		Number of filaments	Length. mm.	Number of filaments	Length. mm.	Number of filaments	Length mm.	Number of filaments	Length mm.	Number of filaments	Length mm.
a-specimen	Right.	13	1.8	5	0.8	12	2.7	13	2.8	15	3.5
	Left.	13		5		12		13		15	
b-specimen	Right.	13	2.3	5	1.2	12	3.2	14	3.3	15	4.0
	Left.	13		5		13		14		15	

In other respects this limb is like that of the type species.

Second antenna: — This is very like that of the type species. In specimen a the end bristle on the endopodite was about the same length as the endopodite, in the other specimen it was relatively somewhat longer (endopodite : end bristle = about 25 : 30).

Mandible: — Protopodite: Basale: In specimen a the longest c-bristle had a few long secondary bristles in the middle, in the other specimen this bristle had only short hairs, as in the type species. Exopodite: The distal bristle is of about the same length as the exopodite or slightly shorter. Endopodite: The first joint: In specimen b there were on the right mandible — contrary to all the other forms of this family investigated by me — five ventral bristles, the shortest one of the four that appear normally was duplicated (presumably an abnormality). Second joint: The bristles on the anterior side are subject to rather great variation; on specimen a there are about ten to fourteen more or less long bristles of varying length with sparse, short hairs and a relatively rather small number of cleaning bristles either not arranged at all or arranged only in indistinct rows (about ten to twelve); the cleaning bristles, as in the type species, vary somewhat in length; they are all bare or have exceedingly fine pectination; the other specimen was, with regard to these bristles, considerably more like the type species, their number being only slightly fewer than in the latter, and among the cleaning bristles the same types could be distinguished. On the posterior side of this joint the former specimen had, in addition to the two distal bristles situated near each other, two to four more bristles, the latter specimen three more. In other respects they were like the type species.

Maxilla: — Protopodite: The first endite has twelve bristles, the right maxilla of specimen a thirteen. The third endite has eight distal bristles, the right maxilla of specimen b only seven; the equipment of these bristles is — as is the case with the rest of the endite bristles of this limb — somewhat weaker than on the type species; bristles nos. 4—7 (4—6 when there are only seven bristles), counting from outside, are quite smooth distally. Exopodite: One of the two long distal bristles has only short hairs. Endopodite: First joint: In specimen a this has three anterior and three posterior distal bristles, in specimen b the right maxilla on this joint has four anterior and four posterior ones distally (as in the type

species), the left maxilla three anterior and four posterior. In specimen a the end joint has three b-bristles and three or four c-bristles, in specimen b four b-bristles and five or six c-bristles. In other respects the maxilla is the same as in the type species.

Fifth limb: — Protopodite: The first endite of specimen a has nine bristles, of specimen b has (on the fifth limb of one side, the other side is defective in this character) twelve bristles, of about the same type as in the type species, but rather more weakly armed. Third endite: The third to the sixth bristles (on the left fifth limb of specimen b even the third to the seventh), counting from the front, have no long secondary bristles at the middle. Exopodite: First joint: On the anterior side of the joint close to the main tooth there is a row of three (on the right fifth limb of specimen b four) bristles, of a type about the same as that of bristles nos. 1, 2 and 5, counting from the main tooth, in the type species. Second joint: On specimen a this has only four a-bristles and eight b-bristles, on specimen b, as on the type species, five a-bristles and nine b-bristles. The fourth exopodite joint has seven bristles in specimen a, eight in specimen b, arranged in two rows in varying ways, all with short hairs. In other respects this limb agrees with the type species.

Fig. XXX. *Giganto-cypris Mülleri* n. sp. var. *minor* n. var. Anterior part of the right valve, seen from within; all the bristles of the rostrum are drawn. × 50.

Sixth limb: — Specimen a: Protopodite: The first endite has two distal and two medial bristles. The second endite has three distal bristles and three medial bristles. The third endite has four or five distal and one or no medial bristle. The epipodial appendage is represented by four short, bare bristles. Exopodite: The endite of the first joint has nine distal bristles and one medial bristle; the second exopodite joint has 24 bristles. Specimen b: Protopodite: The first endite has two distal and two medial bristles; the second endite has four or five distal bristles and two or three medial bristles; the third endite has six distal bristles and one medial bristle. The epipodial appendage is represented by four short, bare bristles. Exopodite: The endite of the first joint has eleven distal and two medial bristles. The second exopodite joint has from 33 to 35 bristles. In both specimens the types of the bristles are the same as in the type species.

Seventh limb: — Specimen a: Cleaning bristles: Distally 30 dorsal and 30 or 31 ventral bristles were situated close together; proximally of these were scattered from 25 to 27 dorsal and from 21 to 23 ventral bristles. Specimen b: Cleaning bristles: Distally on the one limb about 45 bristles were situated close together dorsally as well as ventrally, on the other limb 38 dorsal and 32 ventral bristles; proximally of these on the former limb were spread 34 dorsal and 33 ventral bristles, the other limb was defective with regard to these bristles. In both

specimens these bristles were furnished with three to nine bells of about the same type as in the type species. The end comb had about 40 teeth in specimen a, about 45—50 in specimen b, their type was about the same as in the type species.

F u r c a: — This had 11 or 12 claws on specimen a, 11 on specimen b. Their type was the same as in the type species.

N u m b e r o f e m b r y o s: Specimen a had 27, specimen b 34.

Male: — U n k n o w n.

Habitat: — A t l a n t i c O c e a n:

Lat. 29° 8′ N., long. 25° 16′ W. Depth 1500 metres (caught in an open net); 1. VI. 1910 (S S „M i c h a e l S a r s", station 49 B); t y p e l o c a l i t y: two sexually mature females with fairly far developed embryos.

Genus Cypridina H. Milne Edwards.

Cypridina, a u t o r u m; e. g., H. Milne Edwards, 1840; W. Baird, 1850 a; C. Claus, 1873; G. O. Sars, 1887 and G. S. Brady and A. M. Norman, 1896. *Cypridina* (p a r t.), G. W. Müller, 1906 b and 1912.

Number of sub-genera

Remarks: — As it is to be seen from above p. 193 this genus in the present work has been divided into five sub-genera:

Doloria n.
Vargula n.
Macrocypridina n.
Cypridina H. Milne Edwards.
Siphonostra n.

A genus diagnosis not worked out

On account of the great uncertainty about most of the species belonging to this genus I have considered it convenient not to work out yet a diagnosis of this group. I have confined myself to the elaboration of detailed descriptions of the sub-genera, chiefly based on the species that I have had the opportunity to examine. A consequence of this is, of course, that many of the characters included in these descriptions are of generic value.

Sub-Genus Doloria n. sub-gen.

Description: — Shell: — Its form is somewhat different in male and female, though this difference is rather slight. — It is oval without or with only a weakly developed posterior corner. The rostral incisur is narrow and comparatively deep; near the inner edge of the incisur there are two medial bristles situated close to each other. With rather strong calcification. The species of this sub-genus hitherto known are moderately large.

First antenna: — This is long, slender and has eight joints; for the proportion between the joints see the diagnosis of the sub-family. The sensory bristle of the fifth joint has thirteen sensory filaments. Three of the filaments on bristles b and c are modified in the male for seizing the female. Of these three filaments, all proceeding from the medial side of the bristles, the proximal one issues just at the base of the bristles; this is short and powerful, swollen at the base and strongly chitinized distally, almost spine-like; medially at about half its length it has a single suctorial organ. The two other filaments are relatively long and have distally-medially on one side a series of small suctorial organs all of about the same type and size. The end bristles are not much longer in the males than in the females.

Second antenna: — The protopodite has one medial-distal bristle. Exopodite: The bristle of the second joint is rather powerfully developed. The natatory bristles on the third to the ninth joints are quite without spines. The third to the ninth joints have basal spines. Endopodite: In the male this branch is developed into a powerful triple-jointed clasping organ, the end joint of which has, besides the proximo-ventral bristle, two very short distal ones as well. In the female it is comparatively rather well developed, elongated, and triple-jointed; its end joint is, however, sometimes rather weakly marked. The bristle of the end joint is long.

Mandible: — Protopodite: The endite on the coxale is simple distally or has only indications of bifurcation; its spines are partly rather powerful, especially those situated distally-medially and have only rather a slight tendency towards arrangement in groups. Apart from the bristle of the endite there are no bristles on the coxale. Basale: Of the ventral bristles one d-bristle is very long, has numerous long secondary bristles and is furnished with short hairs distally, the rest vary from being moderately long to very short and have generally short, fine hairs or are quite bare. This joint has three or four bristles dorsally. Endopodite: The first joint has four bristles ventrally. The end joint has six or seven bristles, one of the posterior ones may be missing; — this is noteworthy, as in all the other forms of this sub-family dealt with in this work, as well as in the species of the sub-family *Philomedinae*, seven bristles are always developed on this joint —: the two middle of these bristles are rather powerful, claw-shaped, and about as long and as strong as each other.

Maxilla: — Protopodite: The coxale has dorso-distally a single bristle with long and fine hairs. Proximally on the outside of the third endite there is a single bristle. On the boundary between the basale and the first endopodite joint there are three bristles, one close to the exopodite, one at about the middle of the inside of the endopodite and one on its anterior

edge. Dorso-distally on the coxale there is a rather large lamelliform e p i p o d i a l a p p e n d a g e. The e x o p o d i t e is comparatively well developed, with close, fine, long hairs; it is not displaced distally. The e n d o p o d i t e is broad and moderately long.

S i x t h l i m b: — The second e x o p o d i t e joint is rather short and somewhat rounded with numerous bristles; its posterior-distal bristles are not strikingly large in comparison with the other bristles.

S e v e n t h l i m b: — This has rather numerous cleaning bristles, of which a rather large number are situated very close to each other distally, the rest scattered irregularly along the distal part of the limb. With regard to the position of these latter bristles it is to be noted that on the same side of the same joint there is only extremely seldom more than one bristle. The end comb consists of a moderate number of rather powerful teeth, some rather long, distally rounded distal teeth, smooth except that at the middle they have a small secondary spine on each side, and decreasing somewhat in length the more proximally they are situated, some rather shorter and broader, quite bare proximal teeth rather sharply cut off distally. Dorsally close to the end comb the wall of the limb is rather strongly thickened and also rather deeply concave. The ventral part of the wall in this notch is continued proximally as a peg of chitin with which the chitinous part that forms the dorsal wall of the notch is moveably joined; this latter chitinous part ends dorsally in a freely projecting, rather powerful little verruca. The ventral and the dorsal walls of this notch may be pressed together somewhat like a jaw, when the distal teeth of the end comb are also pressed in towards the dorsal edge of the notch; this compression is carried out by a short, powerful, paired muscle, issuing somewhat proximo-dorsally of the point of the limb and fixed to the bottom of the notch, both to the ventral and the dorsal chitinous hinge. This muscle seems to be a specialized part of the anterior longitudinal muscle of the limb.

F u r c a: — The lamellae are moderately elongated; the number of claws is about eleven; there is no clear division into main claws and secondary claws.

U p p e r l i p: — This has no large processes and is only slightly divided into fields; one can distinguish one anterior upper unpaired field of glands, the openings of which are directed anteriorly-ventrally and two posterior-ventral fields with the openings of the glands directed ventrally; these glandular fields are divided from each other only by shallow grooves. There is an unpaired protuberance on the front between the upper lip and the rod-shaped organ.

The m e d i a n eye is well developed and is of ordinary size and type. The r o d - s h a p e d o r g a n is fairly well developed and rather short and thick.

The l a t e r a l e y e s are well developed.

Number of species.

Remarks: — As far as I know this sub-genus comprises only the two species described below. Possibly one or more additional representatives of it may be found among the rather numerous species of this sub-family that have been dealt with in the literature; on account of the incompleteness of the descriptions nothing can, however, be stated with certainty about this.

Relation between the species.

With regard to the relation between the two species I will only point out here that the form *C. (D.) levis* found at S o u t h G e o r g i a is certainly to be regarded as more divergent

from the common original type than *C. (D.) pectinata.* The great agreement with regard, for instance, to the distal part of the endopodite of the maxilla that the last-mentioned species shows with closely-related forms of other groups, for instance of the sub-genus *Vargula,* decidedly supports this assumption.

On the other hand it is to be stated that they are very like each other; they are certainly very closely related to each other; they may be regarded as representative forms, the one living at South Georgia the other at the Falkland Islands and Tierra del Fuego.

As the type-species of this sub-genus I regard *C. (D.) levis.* *Type.*

C. (Doloria) levis n. p.

Description: — Female: —

Shell: — Length 2,4—2,7 mm.; length : height, about 1,38—1,45 : 1; length : breadth, about 1,9 : 1. Seen from the side (fig. 1) it varies, though rather slightly, in form; it is irregularly oval with its greatest height at or somewhat behind the middle and the posterior part of the shell somewhat larger than the anterior part, sometimes rather more than in the adjoining figure. The dorsal margin is rather boldly arched, flattened anteriorly, sometimes even rather more than in the adjoining figure, sometimes rather flattened posteriorly as well, as in the specimen reproduced, sometimes evenly arched; the ventral margin is much more slightly arched than the dorsal one, its arcuation is even and uniform. The posterior part of the shell is broadly rounded, somewhat flattened with a slight indication of a posterior corner somewhat below half the height of the shell. The anterior margin of the rostrum is well rounded with only a weak indication of a corner, its ventral corner is rather pointed. Seen from below it is egg-shaped with its greatest breadth at or somewhat behind the middle and with gently and uniformly rounded sides; its anterior and posterior ends are rather broadly rounded, the former rather narrower than the latter. The surface of the shell is even and shiny, with rather numerous but exceedingly short and fine hairs. The pores of the surface are small. Seen from inside (cf. fig. 1 of *C. (D.) pectinata*): On the rostrum there is a rather sparse but distinct row of rather long, simple or bifurcate bristles, going slantingly upwards. Some of these bristles, those that are situated most ventrally, are somewhat longer than the others and situated rather closely together; the place on which they are fixed is not developed into a verruciform protuberance. Most of the bristles of this row seem to be quite bare, like the other medial bristles in this species; often, however, some of them at least seem to have along a part of their length short, close and very fine secondary hairs (very difficult to get sight of even with REICHERT's ocular 4. LEITZ' immers. $^{1}/_{12}$). Apart from this row of bristles there are only a few single scattered bristles on the rostrum. Within the inner edge of the rostral incisur there seems to be, besides the two bristles placed close to each other near the edge, as a rule only a single rather short bristle, placed near the joining line. On the list behind the

rostral incisur there is a rather sparse row of moderately long bifurcated bristles (fig. 2); this row becomes more and more sparse posteriorly, and at the same time the bristles become shorter and simple, and already at half the length of the shell it practically ceases altogether; single short simple bristles may, however, be observed on the list along the posterior part of the ventral edge of the shell. Within the posterior margin of the shell the list is rather broad and has from about 20 to 25 short bristles and outside these a varying number of peculiar formations, the nature of which I have not succeeded in establishing with full certainty; probably they are a sort of pores, at any rate they somewhat resemble these formations; seen from the side, they have about the type reproduced in the accompanying figure 3, some of them at least seem to have, if I am not mistaken, an extremely short and fine hair (the verification of this is uncertain even with a magnifying power as large as REICHERT's ocular 4, LEITZ' immers. $^1/_{12}$). On the part between the list and the edge of the shell, both along the ventral edge and posteriorly, there are practically no medial bristles at all. The selvage is rather broad along both the anterior and posterior edges of the rostral incisur; on the other hand it is rather narrow along the anterior edge of the rostrum and along the ventral margin of the shell; it extends, however, rather considerably outside the edge of the shell even in these parts. It has close, even and fine, in most cases almost invisible cross-striation, and is exceedingly finely serrated at the edge, almost quite even.

First antenna: — The posterior distal bristle of the third joint is generally somewhat longer than the bristle of the anterior side of this joint and also somewhat longer than half the length of the fourth joint; the anterior of these two bristles is fixed at about a third of the length of the joint. The two bristles of the fourth joint are generally subequal, not quite as long as the fifth joint. All the bristles mentioned seem, however, to show a not inconsiderable variation with regard to their length. The sensory bristle of the fifth joint is about as long as the anterior sides of the second to the fourth joints taken together; of its thirteen sensory filaments the ten proximal ones are about a third of the length of the whole bristle and are rather considerably thicker than the distal ones, from which they are, in addition, separated by a distinct gap; the two following ones are only a quarter to a fifth of the whole length of the bristle; the remaining, distal one is situated near the point of the bristle and is very short and narrow; they are all of about the same thickness throughout whole their length and quite naked. The a-bristle of the seventh joint is about as long as the fifth joint, the bristle of the sixth joint is somewhat shorter. The bristles of the third, fourth and sixth joints and the a-bristle of the seventh joint are all furnished with short, fine hairs. Of the bristles of the seventh and eighth joints the b-bristle is about the same length as the five distal joints and has five sensory filaments. The c- and f-bristles are subequal and about double the length of the six distal joints; each of these two bristles has ten sensory filaments. The g-bristle is somewhat longer and is characterized by eleven sensory filaments. The proximal filaments on these bristles have from one to six rather short and weak secondary spines, the distal ones are smooth. The sensory tube-like bristles d and e are subequal, about the same length as the six distal joints taken together. Pilosity: The second joint is very sparsely furnished with hairs.

Second antenna: — Protopodite: Length about 0,7—0,8 mm. in specimens about 2,5 mm. long. The medial-distal bristle (fig. 7) is short, about as long as or even somewhat

shorter than the three short bristles on the first endopodite joint (cf. below) and almost bare. Exopodite: This has about the following proportions between the joints:

I : II : III : IV : V : VI : VII : VIII : IX = 38 : 13 : 5 : 4 : 4 : 4 : 3 : 3 : 2.

In other words the first joint is about as long as the total length of all the following joints and the length of the second joint is about as great as that of the three following ones together; the lengths vary somewhat, however, though rather slightly. The bristle of the second joint is about as long as the total length of the six or seven distal joints and has ventrally some rather weak spines, which vary rather considerably in number (from about fifteen to twenty-five) and dorsally, on the average, a rather smaller number of short, still weaker ones. The longest natatory bristles are almost double the length of the whole exopodite and have rather broad natatory hairs. The end joint has four bristles; of these the dorsal one is about as long as the three or four distal joints, its hairs are long but comparatively few in number. The third to the ninth joints have basal spines of the same type as those found in *C. (Vargula) norvegica*, but they are, however, somewhat weaker. Endopodite (fig. 7): The end joint is sometimes not very well defined. The first joint has proximally a group of four bristles, three of which are comparatively short; in addition this joint has at about the middle a single bristle, somewhat longer than the longest proximal one and about as long as or somewhat longer than the two distal joints of the endopodite; all the bristles of the first joint are sparsely furnished with short and fine hairs. The second endopodite joint is quite without bristles. The bristle of the end joint is about double the length of the endopodite and almost reaches the posterior limit of the protopodite.

Mandible (fig. 4): — Protopodite: The endite of the coxale has very numerous spines; its two distal points are generally somewhat stronger and thicker than the other spines, though only slightly so, and, contrary to the latter, are furnished with a few weak secondary spines; between the two distal points a low point can sometimes be observed; cf. above p. 182. Basale: The ventral side has seven bristles; two of them, the a-bristles, are situated at the proximo-ventral corner; one of these is quite short, the other relatively long, attaining about half the length of the ventral side of this joint; the b-bristle is very small; somewhat proximally of the middle of the joint there are two c-bristles, one of which is not quite as long as the longer of the two a-bristles, the other is exceedingly small, even very difficult to distinguish; in addition there are two d-bristles, one of which is quite short, the other long, of about the same length as the second endopodite joint; the last-mentioned bristle has along a great part of its length very numerous rather long secondary bristles, only slightly arranged in groups; the other bristles of the ventral side of this joint are furnished with short hairs or naked. The proximal one of the three bristles of the dorsal side of this joint is situated somewhat in front of the middle of the joint and is about half the length of the latter; the two distal bristles are subequal and rather slightly longer than the proximal one; all three of them have short fine hairs. The exopodite is rather considerably longer than the dorsal side of the first endopodite joint. Of its two bristles, both furnished with short, fine hairs, the one situated most distally is somewhat longer than this branch, the other is about twice as long as the first. Endopodite: Of the four ventral bristles on the first joint the two longest are somewhat

Fig. XXXI. — *C. (Doloria) levis* n. sp., ♀. — 1. Shell, seen from the side; 35 ×. 2. One of the medial bristles of the shell just behind the rostral incisur; 680 ×. 3. A part of the list inside the posterior edge of the shell; 680 ×. 4. Mandible, seen from within; 224 ×. 5. Distal part of the mandible, seen from within; 480 ×. 6. Cleaning bristle, abnormal type, of the second endopodite joint of the mandible; 1000 ×.

different in length; the shorter of these two bristles has rather many fairly long secondary bristles, arranged to some extent in groups, and has short, fine hairs distally; the longer one, like the two short bristles, has short, fine hairs. Second joint: On the proximal half of the anterior side there are fairly numerous bristles: Six or seven more or less long bristles with short, fine hairs, the longest with its point extending somewhat beyond the end joint; the relative lengths of these bristles vary somewhat. Ten or eleven are rather short with fine double pectination (of the type shown in fig. 8 of *M. (Cypridinodes) acuminata* in this treatise; all these bristles are drawn smooth in the adjoining figure). About five or six bristles, also short but armed with coarse double pectination (of the type shown in fig. 9 of *M. (Cypridinodes) acuminata* in this treatise; these bristles are furnished with secondary spines in the adjoining figure). All the bristles of the two last categories, the cleaning bristles, are either clearly arranged in two or three rows running steeply and slantingly forwards and upwards or else situated quite irregularly. There is, however, a transition from one type of cleaning bristles to the other. The variability of these bristles was, on the whole, rather striking, one specimen had a cleaning bristle of the type shown in fig. 6. On the posterior edge this joint has, at about $^3/_4$ of the way along it, a single rather short bristle with short and exceedingly fine hairs or bare and a short distance distally of this bristle two more bare bristles situated close to each other, of the same length and strength as each other, somewhat shorter than the former bristle. All the six bristles of the end joint (fig. 5) are smooth. The two middle ones, which are the most powerful, are about a third of the length of the second endopodite joint. Of the two anterior ones the medial one is claw-shaped and somewhat more than half the length of the two middle ones, the lateral one is considerably weaker and also somewhat shorter than the medial one. Both the two posterior bristles are rather weak and different in length from each other, the longest lateral one is slightly shorter than the two middle main claws. Pilosity: The first endopodite joint has dorso-distally a series of short, stiff hairs; on the second endopodite joint there are proximo-anteriorly and along the posterior edge rather sparse transversal rows of exceedingly short, fine hairs; this limb is otherwise bare.

M a x i l l a: — P r o t o p o d i t e (fig. 9): The equipment of the three endites seems to be fairly constant, though slight variations from the type described and reproduced below may be observed, especially in the relative lengths of the bristles. The first endite has nine or ten bristles of moderate length (on all the specimens investigated except one the first number was found). They are several different types: one, situated at about the middle, is powerful but quite short and has only a few distal and rather powerful secondary teeth; one, situated somewhat outside the former, is of the same type as this but rather considerably larger; one, placed somewhat inside these two, differs from the latter bristle only by its having also some long, stiff secondary bristles at the middle; all the other bristles are subequal and somewhat longer than the former ones; the outer one (or if there are ten bristles the two outer ones) have only rather weak distal secondary teeth; the three inner ones have numerous long, stiff secondary bristles, placed extremely close together; of the two remaining bristles, both with a moderate number of long, stiff secondary bristles, one has very powerful, the other rather weak secondary teeth distally. The second endite has six bristles: the two inner ones of these are rather short

with rather powerful secondary teeth distally, one is of about the same type, but larger and more powerful, the three remaining ones, all somewhat longer than the three others, are rather weakly pectinated distally; the two outer of these usually have on the middle rather sparse and rather long, exceedingly fine hairs. The third endite has also six bristles: the three outer of these are of about the same type as the outer ones on the second endite; of the three remaining ones one is of about the same length as the three former ones, with short, fine hairs or almost bare, one somewhat shorter, rather strong and with rather powerful distal secondary teeth, the remaining one, the inner one, is of about the same length as the last-mentioned one, but weaker and apparently in most cases bare (sometimes missing?). The proximal bristle on the outside of the third endite is nearly as long as the outer edge of this process and has short, fine hairs or is almost bare. The dorso-distal bristle of the coxale is about as long as the outer ones of the distal bristles of the third endite. Of the three bristles on the boundary between the basale and the first endopodite joint the one that is situated close to the exopodite is about as long as the bristles of the last-mentioned branch and is plumose; the two others are almost bare, the one on the anterior edge of the palp is somewhat shorter than the dorso-distal bristle of the coxale, the other still somewhat shorter. Exopodite: Of the three bristles the proximal one is about as long as this branch and has short, fine hairs or is almost bare; the two others are somewhat longer and densely plumose. Endopodite (fig. 10): First joint: This has distally on the anterior edge two rather long bristles, of which the proximal one is somewhat longer than the distal one; both are bare, or else the proximal one is sparsely plumose. On the posterior edge of this joint there are similarly two distal bristles, the posterior one rather long, the anterior one half the length of the posterior one, both with moderately strong pectination distally. The chitinized posterior, verruciformly projecting distal edge of this joint is comparatively weakly developed and varies somewhat in form. The end joint is very strongly chitinized, especially on the inside, which forms a broad, blunt and strong tooth. It has thirteen bristles: four moderately long, rather strongly pectinated a-bristles; three b-bristles, the anterior one of which is moderately long, rather powerful and rather strongly pectinated, the two others are subequal, also rather powerful, straight, spine-like and bare or almost bare, only about half the length of the former one; three c-bristles, of about the same type and size as the anterior one of the b-bristles; three d-bristles, very powerful, very much bent in the middle and quite smooth (from which quality the name of this species is derived), only in exceptional cases can one or more weak secondary teeth be observed on these bristles, the posterior of them is largest and most powerful, the anterior shortest and weakest. Pilosity: On the first endopodite joint there are some transverse rows of fine, rather long hairs.

Fifth limb: — Protopodite: The first endite (fig. 12) has seven bristles. Of these nos. 2, 4 and 5, counting from the anterior side of the limb, are subequal and comparatively long and powerful, equipped distally with numerous rather long and stiff secondary bristles, placed close together in more or less well-defined oblique wreaths. Bristle no. 1 is of about the same type as those already mentioned, but is only about half their length. The three others are still shorter: no. 3 has in the middle a wreath of rather long, stiff hairs and is pectinated distally; no. 6 is rather weak, with thin walls and furnished with a rather small

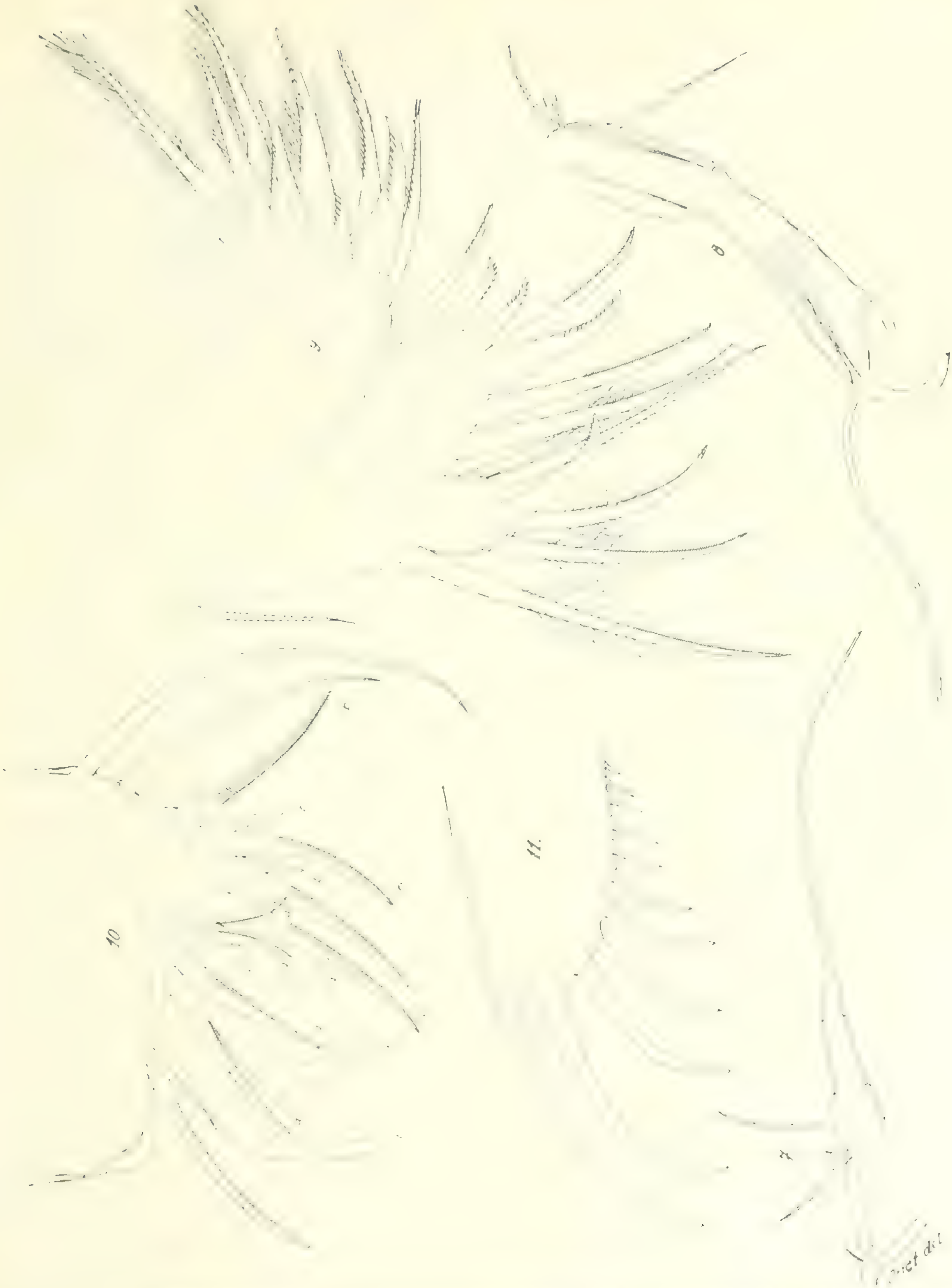

Fig. XXXII. [illegible] 7. Endopodite and the distal part of the protopodite of the second antenna, ♀; 138 ×. 8. Endopodite of the second antenna, ♂; 221 ×. 9. The three endites of the maxilla, somewhat pressed, ♀; 465 ×. 10. Distal part of the endopodite of the right maxilla, seen from outside, ♀; 337 ×. 11. Furca, the teeth of the claws are not drawn; ♀; 138 ×.

number of fine, rather flexible, long, sparse hairs; no. 7 is of about the same type as no. 1, but somewhat stronger. Of the five inner bristles of the second endite (fig. 13) the two anterior ones are rather strong, subequal, moderately long and both of the same type; they are rather strongly pectinated distally and may or may not have a wreath of rather long, stiff secondary bristles proximally of the middle. The posterior bristle is of the same type as the former ones but is considerably more powerful. Of the two middle bristles, both somewhat shorter than the former ones, the anterior is finely serrate distally and has no long secondary bristles; the posterior one, which is the shortest, has in the middle a wreath of long secondary bristles, distally it is smooth or perhaps with a few exceedingly weak secondary teeth. The remaining bristle on this endite, situated on the anterior side of the process, a short distance from the five former ones, is very short and bare. Of the seven bristles of the third endite (fig. 14) the two anterior ones and the posterior one have the same type and about the same size as the corresponding bristles on the second endite, nos. 3 and 4, counting from the anterior side of the limb, agree with no. 3 on the process mentioned, no. 5 is quite short and bare or has a few long and rather soft hairs, no. 6 is moderately long and strong and has short, fine hairs. The distal spine of the protopodite is unusually long and powerful. The epipodite has from 55 to 60 bristles, all furnished with long hairs right to the point. The exopodite has four joints: First joint: The main tooth (fig. 15) has seven constituent teeth all well defined proximally; the secondary teeth on the latter of about the same type as is shown in the adjoining figure, but vary, however, to some extent. The bristle close to the main tooth on the posterior side of the joint resembles in type and size the posterior bristle on the third endite. On the anterior side of this joint there are four bristles, three of which are situated close together in a row near the main tooth, the other one a short distance from these, farther out on the joint; two of the three former ones are subequal and rather long and strong (about the same as is shown in the figure 22 of *C. (Vargula) norvegica*), the third is somewhat shorter; one of the two long ones is rather strongly pectinated distally, the other has exceedingly fine, short hairs distally, both have stiff, long hairs in the middle; the short one has long, stiff hairs in the middle, short hairs distally, almost bare. The outer one of this joint's bristles is somewhat shorter than the two longer of the former bristles and has long, soft hairs along the greater part of its length, short, fine ones distally. Second exopodite joint: This has four powerful a-bristles with numerous moderately powerful secondary teeth continuing almost to the points of the bristles; in addition this joint has eight b-bristles, one c- and one d-bristle; the two latter are somewhat shorter than the longest b-bristles and have rather close, long, soft hairs at the middle and short hairs distally. The outer and inner lobes of the third exopodite joint are well developed (fig. 16); the outer one somewhat larger than the inner one. Each of these lobes has two subequal bristles of moderate length, with long, fine hairs at the middle and short, fine hairs distally. The end joint (fig. 16) is about the same size as the outer lobe of the preceding joint and is furnished with two bristles of the same type and size as the bristles on this joint. Pilosity: The outer lobe of the third exopodite joint and the end joint are partly provided with close, soft, fine, long hairs.

Sixth limb (fig. 17): — Protopodite: The first endite has two or three rather long and strong distal bristles, two of which usually have a few oblique wreaths of long,

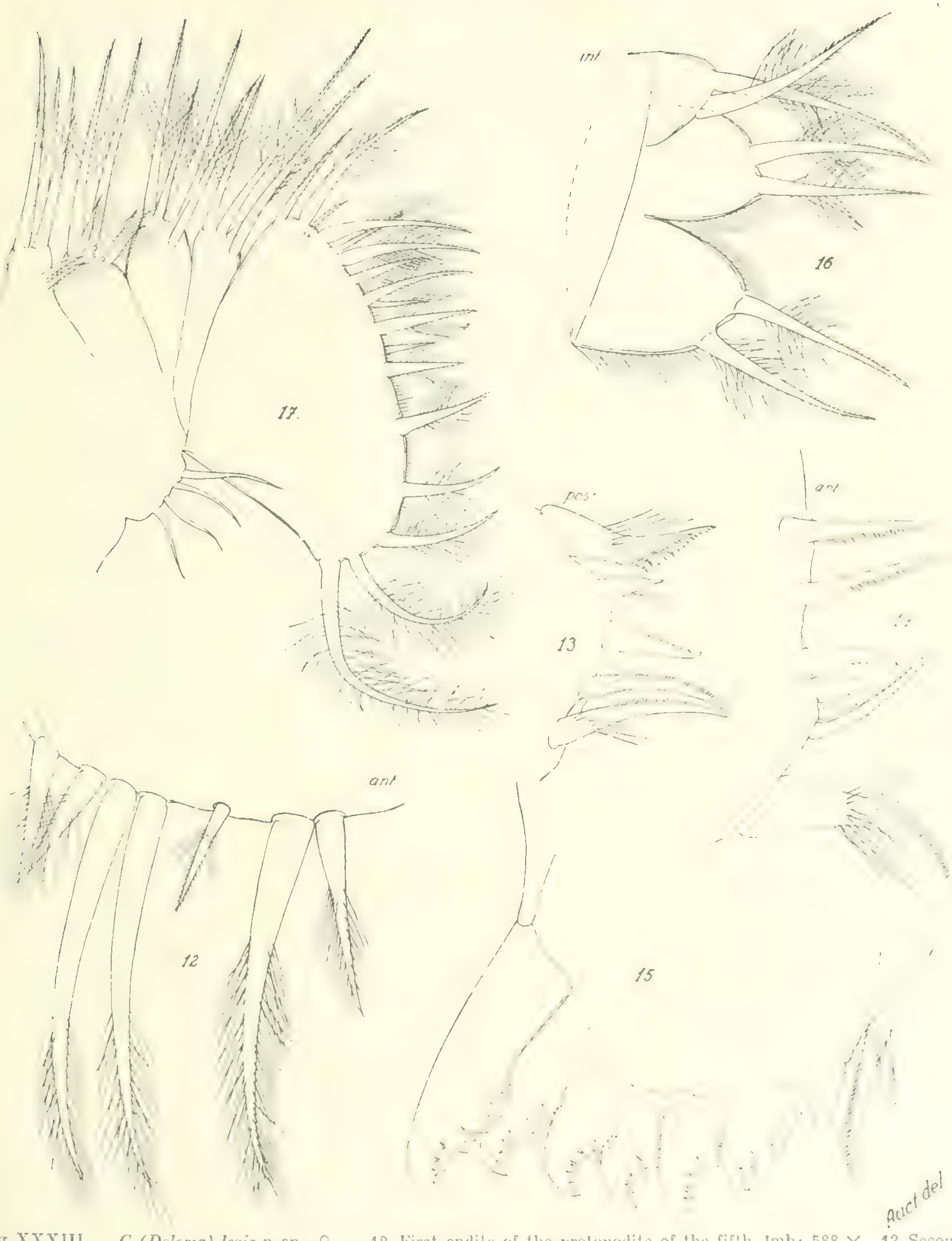

Fig. XXXIII. — *C. (Doloria) levis* n. sp., ♀. — 12. First endite of the protopodite of the fifth lmb; 588 ×. 13. Second endite of the protopodite of the fifth limb; 588 ×. 14. Third endite of the protopodite of the fifth limb; 588 ×. 15. Main tooth of the first exopodite joint of the fifth limb; 700 ×. 16. The two distal exopodite joints of the left fifth limb, seen from behind; 480 ×. 17. Left sixth limb, seen from inside; 240 ×.

stiff secondary bristles, the third, in most cases, with short hairs distally and two short, plumous medial bristles. Second endite: This has two rather long and powerful subequal distal bristles and two or three short, plumous medial bristles. Third endite: This has three rather long and powerful distal bristles of which the middle one is somewhat shorter than the two others, and one medial bristle, of about the same length and type as the long distal bristles. The distal bristles on the second and third endites are of the same type, with a wreath of long and rather stiff secondary bristles at the middle and short hairs distally. The epipodial appendage of the protopodite is represented by four rather short bristles, either with short hairs or bare, issuing from a small, lobe-like process. Exopodite: The endite of the first joint has three or four, usually three, rather long and powerful distal bristles; of these the middle one is somewhat longer than the others and of the same type as the distal bristles on the preceding endite; the ventral one has short hairs, the dorsal one (or the two dorsal ones) usually also with short hairs, sometimes, however with long hairs in the middle. In addition this endite has one medial bristle of the same type and length as that on the preceding endite. Second joint: This has a rather large number of bristle. Eleven or thirteen of these bristles are of moderate length or rather long, all situated very near to the ventral edge; the two posterior ones of them with dense long, soft hairs right to the point, the others with long hairs at the middle and short hairs distally; the long hairs of the last-mentioned bristles are soft on the posterior ones, on the anterior ones they are somewhat more stiff, though only slightly so, and they are not arranged in distinct wreaths. Four or five bristles have short hairs and are generally considerably shorter than the former; some of these are somewhat, though only slightly, displaced from the ventral edge of the joint up the lateral side. There is no pronounced gap between the posterior ones of the bristles of this joint and the others. Pilosity: On the inside this limb has rather close, short, stiff hairs; laterally along the ventral edge of the second exopodite joint there is also a series of short, stiff hairs.

Seventh limb (fig. 18): — This is comparatively short, attaining only half the length of the shell. Distally there are ten or eleven (usually ten) ventral and seven or eight (usually seven) dorsal cleaning bristles, placed very close together. Of these bristles, both in the case of the dorsal and ventral ones, the most distal one is rather short or of moderate length; the next distal one, on the other hand, is comparatively long; starting from this latter bristle these bristles decrease fairly uniformly in length the more proximally they are fixed, though one or two may not follow this rule; the proximal ones are rather short. Proximally of these bristles there are eleven or twelve (usually eleven) ventral bristles and from nine to thirteen dorsal ones scattered irregularly along the distal half of the limb; these bristles are generally subequal and moderately long; their length is, however, somewhat variable. The cleaning bristles are furnished with from three to six bells, transversely cut off distally; (the very short, ventro-proximal cleaning bristle on this limb of the type-specimen, see fig. 18, which was furnished with only a single bell, was apparently pathological); the tongue of the distal bell is cut off very obliquely [type about the same as is shown in fig. 28 of *C. (Macrocypridina) castanea*]; proximally of the bells the cleaning bristles are perfectly smooth. The end comb (fig. 19) consists of from seven to ten distal teeth and of three or four proximal teeth on both sides of these. The distal

wart on the dorsal chitinous plate of the distal cavity has one short, powerful central tooth with several distal points and from two to five short, powerful, conical, bare teeth on each side of this.

F u r c a (fig. 11): — This has eleven claws, all well defined from the lamella and decreasing uniformly in length the more proximally they are fixed; no. 4 is, however, rather often somewhat short and weak comparatively; proximally of the claws the furca is smooth.

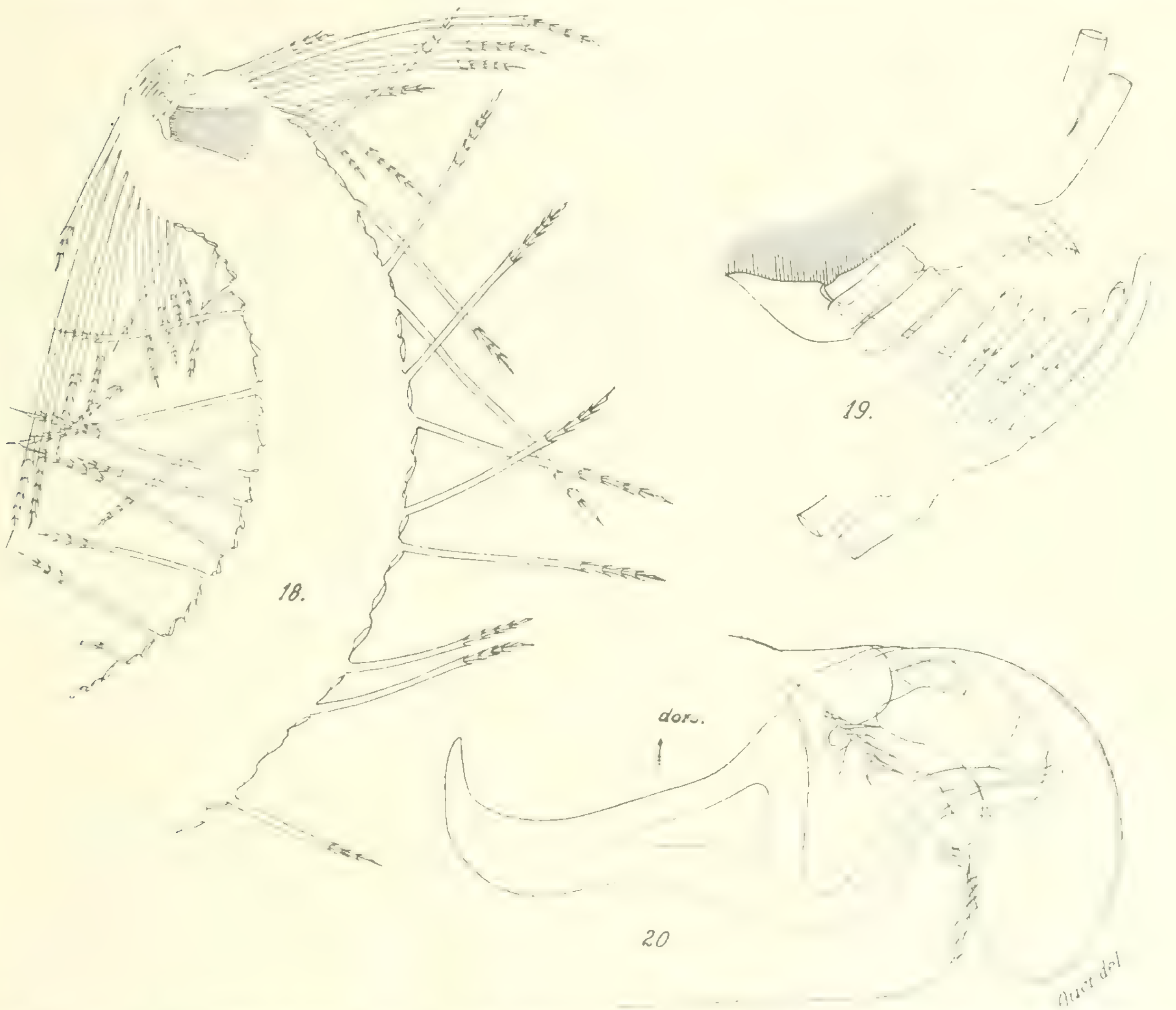

Fig. XXXIV. — *C.* (*Doloria*) *levis* n. sp. — 18. Seventh limb; 240 ×. 19. The point of the seventh limb; 1000 ×. 20. Left penis, seen from inside, (drawn as if it were semi-transparent); 312 ×.

U p p e r l i p: — The unpaired dorsal glandular field, like the paired ventral one, is of moderate size. The unpaired protuberance dorsally of the upper lip is of moderate size, somewhat conical, distally rounded.

The r o d - s h a p e d o r g a n: — This is somewhat pointed distally (the upper lip and the rod-shaped organ present a picture that reminds one very much of G. W. MÜLLER's picture of these organs in *Cypridina dorsoserrata*, 1908, pl. IV, fig. 3, but the dorsal glandular

field on the upper lip is situated more in one plane; besides, as has been pointed out above, the dorsal protuberance between the upper lip and the rod-shaped organ has only a single point).

The lateral eyes are large.

Male: —

Shell: — Length: 2.1—2.2 mm.; length : height, about 1.4 : 1. Seen from the side: The greatest height is situated about at the middle; the posterior part of the shell is not perceptibly larger than the anterior part. The dorsal border is somewhat less flattened anteriorly than in the female. With a rather well-developed, broadly rounded posterior corner somewhat ventrally of half the height. In other respects the male shell is like that of the female.

First antenna: — The bristles of the third and fourth joints seem to be somewhat, though rather slightly, shorter than these bristles in the female. Bristles of the seventh joint: The b-bristle is about as long as the anterior side of the second to the fourth joints; it has four filaments, of which the three proximal ones have suctorial organs and the distal one, which issues close to the distal of the three former ones, is short and bare; the proximal filament has a powerful, rounded, verruciform process distally of the suctorial organ [about the same as in figure 15 of *C. (Vargula) norvegica*]; the two other filaments with suctorial organs are rather long and powerful, the distal one extending somewhat beyond the point of the principal bristle, and having four suctorial organs distally, proximally of which a small wart, like a shaft of still another suctorial organ, is to be found. The c-bristle is somewhat longer than the preceding bristle; it has nine filaments; of these the three proximal ones have suctorial organs and are of exactly the same types as the filaments with suctorial organs on the b-bristle. Bristles of the end joint: The f- and g-bristles are about as long as the whole antenna, the latter only slightly longer than the former; the f-bristle has ten, the g-bristle eleven filaments. In other respects this antenna agrees with that of the female.

Second antenna: — The protopodite and the exopodite are similar to those of the female. The endopodite (fig. 8): The first and the second joints are rather long and powerful, the latter not quite twice as long as the former, both almost uniformly thick; the end joint is about a third of the length of the second joint, narrow, of about the same thickness throughout its whole length, curved ventrally and distally furnished with a few irregular teeth. The bristles of the first joint completely agree with those on this joint in the female. The second joint has, at about two-thirds of the way along it, two subequal rather short ventral bristles. The proximo-dorsal bristle of the end joint is somewhat shorter than the total length of the two proximal joints; close to the point of the end joint there are two exceedingly short bristles placed close together.

The mandible, maxilla, fifth and sixth limbs are similar to those of the female.

Seventh limb: — This also shows a great agreement with that of the female, but the end comb seems, however, to be somewhat weaker; it has from nine to eleven distal teeth and on each side of these from two to four proximal teeth.

P e n i s: — This is of the fundamental type for this sub-family. For details see the accompanying figure 20. There seem to be no glands on the ventral lobe.

F u r c a: — Very like that of the female; the two or three distal claws are, however, somewhat more curved.

The r o d - s h a p e d o r g a n and the u p p e r l i p agree with these organs in the females.

The l a t e r a l e y e s are slightly larger than those of the females.

The d o r s a l s i d e o f t h e b a c k o f t h e b o d y has rather strong transverse folds or ridges.

Habitat: — S o u t h G e o r g i a:

S. A. E., Station 18, mouth of West Fjord, Cumberland Bay, lat. 54° 15′ S., long. 36° 25′ W.; 22. IV. 1902; depth, 250 m.; loose clay; temperature at the bottom, + 1,2° C.: 1 mature female; R. M. S. 151. S. A. E., Station 25, off Grytviken, lat. 54° 22′ S., long. 36° 27′ W.; 21. V. 1902; depth, 24–52 m.; greyish clay with scattered algae: 2 juvenes; R. M. S. 152. S. A. E., Station 26, off Grytviken, lat. 54° 22′ S., long. 36° 27′ W.; 24. V. 1902; stony bottom with algae just outside the Macrocystis-region: 1 mature female, 1 mature male and 16 larvae of different stages; R. M. S. 153. S. A. E., Station 34 (t y p e - l o c a l i t y), off the mouth of Cumberland Bay, lat. 54° 11′ S., long. 36° 18′ W., 5. VI. 1902; depth, 252—310 m.; greyish clay with scattered stones; temperature at the bottom, + 1,45° C.: 1 mature male, 17 mature females and 7 larvae of the first stage; R. M. S. 154.

Type specimen, on slides, R. M. S.

C. (Doloria) pectinata n. sp.

Description: — F e m a l e:

S h e l l: — Length, 2,45—2,8 mm. It agrees completely with the shell of *C. (D.) levis.* The peculiar formations (pores?) of the list inside the posterior border of the shell are, on the average, somewhat more numerous?

F i r s t a n t e n n a: — This agrees very closely with that of the preceding species; a slight, but apparently constant, difference is, however, to be noted with regard to the sensory bristle of the fifth joint. Of the ten long proximal sensory filaments that distinguish this bristle of the preceding species, the distal one is in this species displaced rather much distally and is, in addition, somewhat shortened and narrowed; it thus constitutes a sort of transitional form to the more distally situated filaments, the sharp division into long, somewhat thicker proximal sensory filaments and short, narrow, distal ones being thus less marked in this species. On one specimen two (normally only one) subequal anterior distal bristles were observed on the fourth joint on the antenna of one side.

S e c o n d a n t e n n a: — P r o t o p o d i t e: The medial-distal bristle is rather long, about twice as long as the three shorter of the four proximal bristles of the first endopodite

joint, yet not quite so long as the longest of these four bristles. The e x o p o d i t e agrees very nearly with that of the preceding species. It differs from this principally in the following respects: The bristle of the second joint is furnished with rather strong ventral secondary spines, somewhat fewer in number than in the preceding species (from about ten to fifteen). The basal spines on the third to the ninth joints are comparatively rather stronger, they attain about the same development as in *C. (Vargula) norvegica*. The short, dorsal one of the four bristles on the end joint has rather numerous long natatory hairs. The e n d o p o d i t e has quite the same type as in the preceding species. On one specimen I found the abnormal type that is reproduced in the adjoining figure 2 developed on the antenna of one side; that of the other side was perfectly normal.

M a n d i b l e: — P r o t o p o d i t e: The endite of the coxale is furnished with a moderate or sometimes rather large number of spines; its two distal points are rather considerably stronger than the other spines, and are, unlike the latter, furnished with a few secondary spines; between these two points there is a low verruciform process (cf. above p. 182). Basale: This joint has eight bristles ventrally: three a-bristles, one b-bristle, two c-bristles and two d-bristles. The a-bristles are all relatively short, somewhat different in length from each other, the longest one about a quarter to a third of the length of the longest a-bristle in the preceding species. The longest c-bristle is slightly shorter than the corresponding bristle in the preceding species. The shortest of the d-bristles is in most cases somewhat displaced proximally; otherwise these bristles show agreement in length, equipment and situation with the corresponding bristles in *C. (D.) levis*. The dorsal side of this joint has four bristles: Three of these have about the same type, length and position as the three dorsal bristles on this joint of *C. (D.) levis*, except perhaps that the bristle just in front of the middle of the joint in the latter species is comparatively somewhat shorter. The fourth of these bristles — which is noteworthy because no bristle of this kind occurs in any of the other species belonging to this sub-family that have been described in this work — has short, fine hairs, almost bare, is rather short, only about a third of the length of the bristle situated just in front of the middle of the joint, and is placed rather near the proximal limit of this joint. The e x o p o d i t e has about the same size and type as in the preceding species; its end bristles are perhaps comparatively slightly shorter. E n d o p o d i t e: Of the four ventral bristles on the first joint the two longest ones are somewhat different in length from each other; the longest, which is somewhat longer than the posterior side of the second endopodite joint, has rather numerous long secondary bristles, only indistinctly arranged in groups, the other three have short hairs. The second joint, as in the case of the preceding species, has on the proximal half of the anterior side a moderate number of bristles: from nine to twelve more or less long bristles with short, fine hairs, of about the same proportions as the corresponding bristles in the preceding species and, as in this species, of somewhat varying lengths, and, in addition, about sixteen to twenty cleaning bristles (their number and development difficult to ascertain with certainty because of their very dirty condition), more or less distinctly arranged in from two to four steep rows directed obliquely upwards and forwards; the cleaning bristles are of two types as in the preceding species, some with exceedingly fine double pectination, some with coarser pectination; the difference in pectination is, however, not so striking, the transition

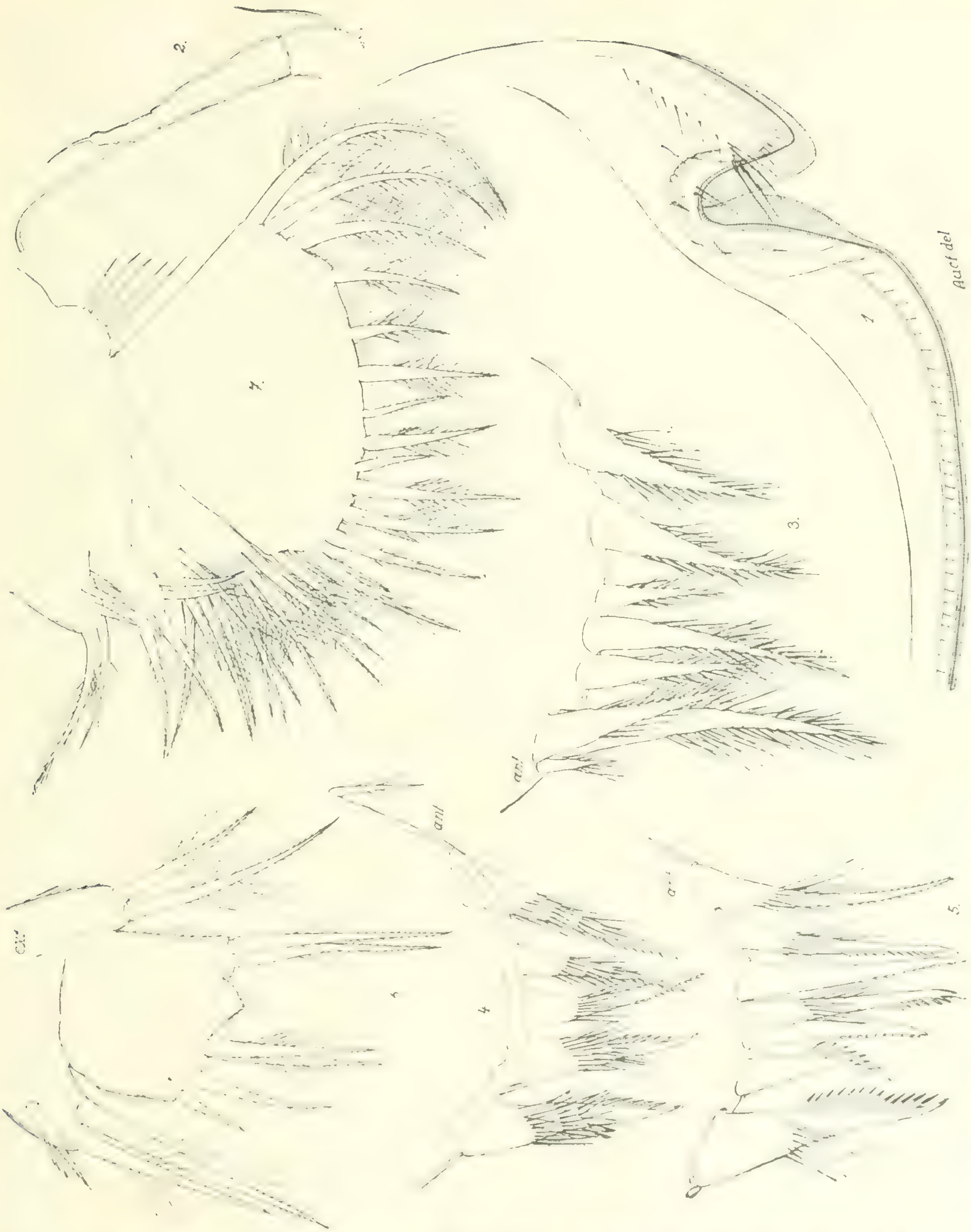

Fig. XXXV. — *C. (Doloria) pectinata* n. sp., [illegible] — 1. Anterior part of the left valve, seen from inside; 8[illegible] ×. 2. Exopodite of the second antenna, abnormal type; the proximal bristles of the first joint, [illegible] the long bristle of the [illegible] joint, are broken; 152 ×. 3. First endite of the protopodite of the fifth limb; 480 ×. 4. Second endite of the protopodite of the fifth limb; 480 ×. 5. Third endite of the protopodite of the fifth limb; 480 ×. 6. The two distal exopodite joints of the left fifth limb, seen from before; 428 ×. 7. Right sixth limb, seen from inside; 240 ×.

is almost continuous. The two postero-distal bristles on this joint, which are situated close to each other, are similar to those of the preceding species. Proximally of these there are generally — as in the majority of species belonging to this sub-family that are dealt with in this work — two bristles, generally of equal length and of about the same type and length as the two former ones, one situated somewhat proximally of the other; in a few cases, however, three such bristles were observed, of which the two proximal ones were situated close to each other, and sometimes only one such bristle was developed. End joint: This has, in addition to the six bristles observed on the preceding species, a very short bristle, situated posteriorly; (of the same type as, for instance, in *C. (Vargula) norvegica*; cf. fig. 12 of this species). The six bristles have about the same development as these bristles in the preceding species, apart from the fact that the two anterior ones and the two posterior ones are relatively somewhat, though rather slightly, longer. The three claws have a few weak posterior secondary teeth proximally of the middle, the longest anterior and posterior bristles have short, weak posterior hairs or are almost bare. The pilosity of this limb is similar to that of the preceding species.

Maxilla: — Protopodite: The first endite (fig. 8) has twelve rather powerful subequal, moderately long bristles, furnished with abundant stiff, long secondary bristles placed close together; only the outer bristle has comparatively few of these; on the three inner bristles these secondary bristles continue right to the point of the bristle, on the others they stop a short distance from the point; of the latter bristles four are trifurcated distally, five have a strong, simple point and are with or without powerful distal secondary teeth. The second endite (fig. 9) has seven moderately long bristles, which decrease somewhat in length the farther inward they are placed; they all have at the middle a moderate number of long, stiff secondary bristles, and five of them have, in addition, more or less strong distal secondary teeth. The third endite (fig. 10) is similarly furnished distally with seven bristles of moderate length, the exterior ones somewhat longer than the interior ones; all except the innermost, which has short and exceedingly fine hairs, have a moderate number of long, stiff secondary bristles at the middle; the two outer ones are finely pectinated distally, the third outer one is somewhat more strongly pectinated distally, the rest, as far as I could see, smooth distally. The bristle situated proximally on the outside of the third endite has short and fine hairs and is not quite as long as the outside of this process. The dorso-distal bristle on the coxale is about as long as the outer bristle on the third endite. Of the three bristles that are situated on the boundary between the basale and the first endopodite joint the one situated close to the exopodite is about as long as the distal bristles of the exopodite and is plumose in the middle, the one on the anterior edge of the palp is somewhat shorter than the dorso-distal bristle on the coxale, the one on the inside of the palp is somewhat shorter still; the two last-mentioned bristles have short, fine hairs or are almost naked. Exopodite: Of its three bristles the distal one has short, fine hairs, the two others are densely plumous; one specimen had all three densely plumose. The two distal ones are somewhat longer, the proximal one somewhat shorter, than the exopodite. Endopodite (fig. 11): First joint: This has two rather long bristles distally on the anterior edge, the anterior one somewhat longer than the posterior one, both with short, fine hairs or almost bare. Distally on the posterior edge there are three bristles, one rather long, the two others

about half the length of this one or somewhat shorter; all are pectinated distally, the two shorter ones rather weakly, however. The cutting part of the posterior distal edge of this joint is of about the same type as in the previous species. The end joint is rather strongly chitinized, but not so strongly as in the preceding species, nor does it form an inner tooth-like, powerfully chitinized process as in the case of the species mentioned. It is furnished with exactly the same bristles as in the preceding species; most of these bristles are, however, developed quite differently from those of the latter: Four a-bristles of the same size and strength as these bristles in *C. (D.) levis*; the posterior ones of these are weakly and sparsely pectinated in the middle, the anterior ones are bare or have a few fine, short secondary spines. Three b-bristles, of which the anterior one is moderately long, the two others about half the length of this one, all strongly pectinated, the two short ones, however, having rather few secondary spines. Three c-bristles, of which the posterior one has about the same type and size as the anterior b-bristle or else is somewhat shorter, the middle one agrees fairly well with the two short b-bristles and the anterior one is very short, bare or only having sparse, short, fine secondary spines. Three d-bristles, rather long, subequal, powerful like these bristles in *C. (D.) levis*, but only weakly and uniformly curved and very strongly pectinated (from which character the species derives its name); on the posterior one of these bristles the secondary spines are more numerous than on the anterior ones. Pilosity: The first endopodite joint has transverse rows of fine and rather short hairs.

F i f t h l i m b: — P r o t o p o d i t e: The first endite (fig. 3) is furnished with eight bristles, of about the same type, powerful masticatory bristles armed with long, stiff secondary bristles situated close together and more or less clearly arranged in obliquely placed wreaths. On all the specimens investigated, five in number, from F a l k l a n d I s l a n d s and T i e r r a d e l F u e g o, the proportion between these bristles was about the same: Bristles nos. 3, 5, 7 and 8, counting from the anterior side of the limb, were rather long, decreasing somewhat in length the more posteriorly they were placed; nos. 2, 4 and 6 form a similar series, but are considerably shorter; no. 1 is very small. The five inner bristles of the second endite (fig. 4) are powerful, subequal, and of moderate length. The two anterior ones and the two posterior ones are of about the same type, the latter being, however, somewhat more powerful; distally they are furnished with powerful secondary teeth and in the middle with some obliquely situated wreaths of long, stiff secondary bristles. The middle bristle is finely serrated distally and has one or a few wreaths of long, stiff secondary bristles at the middle. The remaining bristle of this process, situated on the anterior side at some distance from the five former ones, is short and almost bare, with only a few long, stiff secondary bristles. The seven bristles of the third endite are moderately long (fig. 5), subequal except for bristles nos. 5 and 6, counting from the anterior side of the limb, which are somewhat shorter, no. 6 being rather shorter than no. 5. They are all powerful, especially no. 7; bristles nos. 1, 2, 4 and 7 have at the middle long, stiff secondary bristles arranged in a wreath, the others are, in most cases, without such armament. Bristle no. 1 has short hairs, nos. 2 and 4 have rather powerful secondary teeth, nos. 3 and 5 are finely and sharply serrated distally, nos. 6 and 7 have very powerful secondary teeth distally. The distal chitinous spine of the protopodite is relatively somewhat shorter than in the preceding species. The e p i p o d i a l p l a t e has the same number and type of bristles as in the

Fig. XXXVI. — [illegible] n. sp. [illegible] Maxilla. — 8. First endite of the protopodite [illegible]. — 9. Second endite of the protopodite, [illegible]. — 10. Third endite of the protopodite; [illegible]. — 11. Distal part of the left endopodite, seen from inside [illegible].

preceding species. The exopodite is four-jointed. First joint: The main tooth has seven constituent teeth, all well defined proximally; the secondary teeth of the latter vary to some extent, approaching the type reproduced for *C. (Vargula) norvegica*. The bristle close to the main tooth on the posterior side of the joint is of about the same size as in *C. (D.) levis* and, as in this species, has long, stiff secondary bristles proximally of the middle; at the middle it has a few powerful secondary teeth, distally it is smooth. On the anterior side of the joint there are four bristles of the same type and position as in the preceding species. The second exopodite joint has exactly the same number and position of its bristles as in the preceding species: four a-bristles, eight b-bristles, one c- and one d-bristle; these bristles also show a far-reaching agreement with this species in type and size, but the equipment of the a- and b-bristles is obviously more powerful in the form dealt with here. The outer and inner lobes of the third joint (fig. 6) are comparatively small, considerably smaller than the end joint. The inner lobe has three bristles, two rather long and powerful distal bristles, somewhat different from each other in length, and a very short one, situated proximally on the posterior side; all three of them have long secondary bristles at the middle and short, fine hairs distally. The outer lobe has two bristles, situated distally, whose type and size are about the same as those of the distal bristles on the inner lobe of this joint; they are sometimes subequal, sometimes the outer one is somewhat shorter than the inner one. The end joint (fig. 6) is rather large, almost square in shape and shows traces distally and outwards of a little verruciform fifth joint. On the latter process there are two bristles, of about the same length and type as the two bristles on the outer lobe of the preceding joint. Besides these bristles the end joint has distally near the medial edge three or four, usually four, bristles of which the inner ones are somewhat shorter than the outer ones, all somewhat shorter than the two outer bristles of this joint; the outer ones of these four are usually of the same type as the two last-mentioned bristles, the inner ones often have short hairs. Pilosity: The outer lobe of the third exopodite joint and the end joint have close, fine hairs.

Sixth limb (fig. 7): — Protopodite: The first endite has two rather long and powerful distal bristles, furnished with a few oblique wreaths of long, stiff secondary bristles, and two to three short, plumous medial bristles. The second endite has two rather long and powerful, subequal distal bristles, with a wreath of long, stiff secondary bristles at the middle and short hairs distally; in addition it has three rather short, plumous medial bristles. The third endite has four distal bristles, of which one of the dorsal ones is rather short and powerful, with a wreath of long, stiff secondary bristles at the middle, and bare distally; the other three are rather long and powerful, subequal, all of them sometimes of the same type as the distal bristles of the second endite, sometimes two of them have short hairs; this joint has, in addition, one medial bristle of about the same type and length as the distal bristles on the preceding endite. The epipodial appendage of the protopodite is represented by 5 rather short bristles, either with short hairs or bare, fixed on a small, lobe-like process. Exopodite: The endite of the first joint has from six to eight distal bristles, one of which is of about the same type and size as the short distal bristle on the previous endite, a couple of ventral ones also rather short, but weak with short hairs, the rest subequal, rather long and powerful, most of them

with long, stiff secondary bristles at the middle, distally they have short hairs or are bare; this endite has one medial bristle, of about the same type and size as that of the preceding endite. The second exopodite joint is slightly shorter than that of the preceding species. It has a rather large number of bristles, all situated very near the ventral edge of the joint. The two (sometimes the three) posterior of these bristles are rather long, with long, soft hairs right to the point. There is no pronounced gap between these bristles and the others. Ten to seventeen of the remaining bristles are of moderate and somewhat varying lengths, with long hairs at the middle and short hairs distally; their long hairs are not arranged in distinct wreaths, those on the posterior of these bristles are rather soft, those on the anterior ones are more stiff, even somewhat stiffer than in the preceding species. From six to twelve bristles have short hairs, are, as a rule, not inconsiderably shorter than the other bristles on this joint and are somewhat, though only slightly, displaced from the ventral edge of the joint up the lateral side. The pilosity is similar to that of the preceding species.

Seventh limb: — This is very similar to that of the preceding species. The following differences are to be noted: Distally there are from eleven to thirteen ventral cleaning bristles and nine or ten (usually nine) dorsal ones placed very close together. Scattered irregularly proximally of these there are eleven or twelve ventral and from ten to fourteen dorsal cleaning bristles. The cleaning bristles are equipped with from three to seven bells. The end comb consists of from ten to thirteen distal teeth and five or six proximal teeth on both sides of these. The distal wart on the dorsal chitinous plate of the distal cavity is of about the same type as in the preceding species, its central tooth, however, seems always to have a single point. In other respects this limb is similar to that of the preceding species.

Furca: — This is very like that of the preceding species, with the same number of claws, all well defined from the lamellae. The fourth claw is usually somewhat short and weak comparatively, sometimes its weakness is even rather striking. The curvature of the

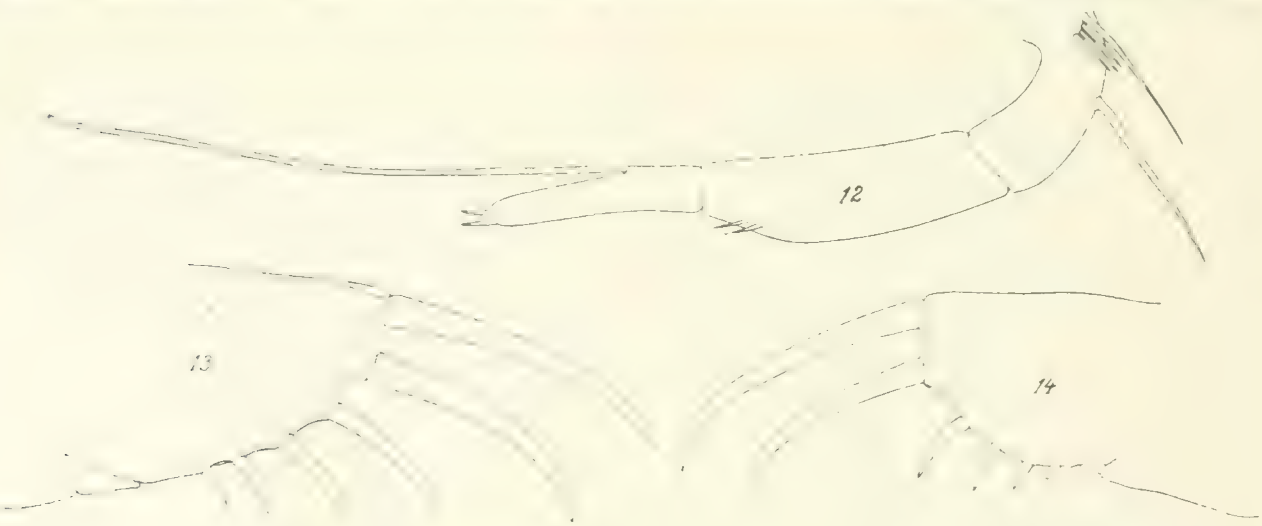

Fig. XXXVII. — *C. (Doloria) pectinata* n. sp. — 12. Endopodite of the second antenna of a male larva in Stage I; 224 ×. 13. Furca of a larva in Stage IV; the teeth of the claws are not drawn; 224 ×. Furca of a larva in Stage V; the teeth of the claws are not drawn; 224 ×.

claws is perhaps, on the average, somewhat weaker, though only slightly so, than in the species mentioned.

The frontal organ, upper lip and lateral eyes are similar to those of the preceding species.

Male: —

Shell: — This agrees both in shape and length with the male shell of the preceding species.

With regard to the other organs but little information can be given, as they were in so damaged and dirty a condition in the only specimen accessible that it was impossible to carry out a detailed investigation with any certainty. As far as could be seen, the exopodite of the second antenna, the mandible, maxilla and fifth, sixth and seventh limbs seemed to agree closely with these organs in the female. The endopodite of the second antenna was very like this organ in the male of the preceding species.

Habitat: —

Falkland Islands:

S. A. E. Station 58, lat. 52° 29′ S., long. 60° 36′ W. (type locality); 11. IX. 1902; depth, 197 m.; sand and gravel; temperature at the bottom, + 4,1° C.: several mature females and larvae of different stages; R. M. S. 147. S. A. E. Station 59, on the Burdwood Bank, lat. 53° 45′ S., long. 61° 10′ W.; 12. IX. 1902; depth, 137—150 m.; mussel sand with scattered stones: 3 juvenes; R. M. S. 149.

Tierra del Fuego:

S. A. E. Station 60; east mouth of the Beagle Channel, lat. 55° 10′ S., long. 66° 15′ W.; 15. IX. 1902; depth, 100 m.; bottom of broken shells; temperature at the bottom + 5,0° C.: 12 mature females, 1 mature male and about 50 larvae of different stages; R. M. S. 148. S. A. E. Station 62, Beagle Channel, lat. 54° 53′ S., long. 67° 56′ W.; 16. IX. 1902; depth, 140 m.: clay mixed with sand: 1 mature female; R. M. S. 150. S. M. E., Puerto Condor; 26. II. 1896; depth, 72 m.: 2 mature females; R. M. S. 146. S. M. E., Puerto Harris; 11. III. 1896; depth 27 m.; bottom of dead shells: 1 mature female and 3 larvae; R. M. S. 145. S. M. E., Cap Valentyn; 12. III. 1896; depth 270 m.; bottom of dead shells: 5 mature females; R. M. S. 144.

Type-specimen, on slides, R. M. S.

Sub-Genus Vargula n. sub-gen.

Cypridina (part.), autorum.

Description: — Shell: — The shape is somewhat, though rather slightly, different in males and females. — It is oval, with or without a weakly developed posterior corner. The rostral incisur is most frequently narrow and comparatively deep, only in exceptional cases quite shallow. Near the inner edge of the incisur there are two medial bristles situated close to each other. With rather strong calcification. All the species hitherto known are rather large.

F i r s t a n t e n n a: — This is long and slender and eight-jointed. The sensory bristle of the fifth joint has thirteen sensory filaments. The b- and c-bristles of the males are generally characterized by quite the same modification as described above, p. 223, for the sub-genus *Doloria*; in exceptional cases the former of these two bristles has only one filament with a series of small distal suckers; see *Cypridina mediterranea*, G. W. MÜLLER, 1894, pl. 2, fig. 20. The end bristles are sometimes rather slightly longer in the males than in the females, sometimes in the former sex bristles f and g are considerably longer than in the latter.

S e c o n d a n t e n n a: — The p r o t o p o d i t e has a medial-distal bristle. The bristle on the second joint of the e x o p o d i t e is rather powerfully developed. The natatory bristles on the third to the ninth joints have no trace of spines. The third to the ninth joints have basal spines. The e n d o p o d i t e is similarly developed in males and females, being either comparatively well developed, rather elongated and three-jointed or more or less reduced, with a reduction in the number of joints. The bristle of the end joint is comparatively long.

M a n d i b l e: — P r o t o p o d i t e: The endite on the coxale is weakly bifurcated distally; some of its spines are rather strong, especially those situated medially-distally; at least some are arranged in rather distinct groups. Apart from the little bristle situated dorsally on this process this joint has no bristles. Basale: Of the ventral bristles one d-bristle is very long, has numerous long secondary bristles and is furnished with short hairs distally; the others are of moderate length or short and have short, fine hairs or are naked. Dorsally this joint has three bristles. E n d o p o d i t e: The first joint has four bristles ventrally. The end joint has seven bristles, of which the two middle ones are the most powerful, claw-like, and of about the same length and strength as each other.

M a x i l l a: — P r o t o p o d i t e: The coxale has a single bristle dorso-distally with long, fine hairs. There is a single bristle proximally on the outside of the third endite. The bristles on the boundary between the basale and the first endopodite joint vary somewhat; sometimes three are developed, one close to the exopodite, one medially at about the middle of the palp and one on the anterior edge of the palp; this last bristle is, however, sometimes missing. There is a rather large lamelliform e p i p o d i a l a p p e n d a g e dorso-distally on the coxale. The e x o p o d i t e is comparatively well developed, with close, fine, long hairs and not displaced distally. The e n d o p o d i t e is broad and of moderate length.

S i x t h l i m b: — The second e x o p o d i t e joint is rather short, somewhat rounded and has numerous bristles. Its posterior bristles do not dominate strikingly over the other bristles. (G. W. MÜLLER states, 1894, p. 68, that the e p i p o d i a l a p p e n d a g e of the protopodite in the genus *Cypridina*, s e n s u G. W. MÜLLERI, is always characterized by four bristles; that this is not the case is shown by the descriptions of the species given below.)

S e v e n t h l i m b: — This is furnished with rather numerous cleaning bristles, a large number of which are placed close together distally, the rest scattered irregularly along the distal part of the limb. With regard to the position of these latter bristles it is to be noted that only exceedingly seldom or perhaps never is there more than one bristle on the same side of the same joint. The end comb consists of a moderate number of rather strong teeth, some rather long, distally rounded or more or less pointed distal teeth, smooth except for a little

secondary spine at the middle of each side, some somewhat shorter and broader proximal teeth, cut off rather transversally distally. Dorsally, close to the end comb, the wall of the limb is somewhat thickened and has a more or less weak chitinous wart. It is also somewhat concave at this point, the depth of the concavity varying. The dorsal and ventral walls of the cavity are not moveably joined to each other, but at least in some forms they may, however, be pressed somewhat towards each other like a jaw, when the distal teeth of the end comb are pressed in towards the dorsal wall of the cavity (see fig. 14 of *C. (V.) megalops*). This compression is effected by a paired short, powerful muscle, which issues proximally somewhat proximo-dorsally of the point of the limb and is fixed distally to the bottom of the cavity. This muscle is sometimes absent; whether in this case the distal teeth can be pressed in or not I am not able to decide, as I have had only preserved material of these forms at my disposal; I merely point out here that these teeth were not pressed in on any of the numerous specimens of species without this muscle that I investigated, while they were pressed in very often on specimens of species with it.

F u r c a: — The lamellae are moderately elongated. The number of claws from about nine to eleven, without, or in some cases with, division into main claws and secondary claws.

U p p e r l i p: — This has three glandular fields: an anterior one, unpaired, moderately large, in which the exits of the glands are directed obliquely forwards and downwards, and two paired ones, situated somewhat ventrally of the former, the exits of which are directed somewhat more ventrally. The two latter are sometimes comparatively small and situated distally on a couple of large tusk-like processes, sometimes they are of moderate size and not raised; even in the last-mentioned case, however, the three fields of glands are separated from each other by rather deep grooves. There is an unpaired protuberance on the front between the upper lip and the frontal organ.

The r o d - s h a p e d o r g a n is well developed and rather short and thick.

The l a t e r a l e y e s vary in their development; sometimes they are almost completely reduced.

Remarks: — Besides the three species described below we have probably to include in this sub-genus a rather large number of the species grouped together by G. W. MÜLLER in his work of 1912 under the generic name *Cypridina*. Of these species I merely mention here: *Number of species.*

Cypridina mediterranea, O. COSTA, 1845, (G. W. MÜLLER, 1894, p. 206, pl. 2, figs. 1, 2, 4, 5, 8—20, 22—27, 33).

„ *dorsoserrata*, G. W. MÜLLER, 1908, p. 83, pl. IV, figs. 1—3, 5—10.

„ *Sarsi* G. W. MÜLLER; G. O. SARS, p. 43 (215), pl. III, figs. 1, 2, pl. VIII, figs. 6, 7.

„ *Vanhöffeni*, G. W. MÜLLER, 1908, p. 82, pl. V, figs. 1—8, 13.

„ *squamosa*, G. W. MÜLLER, 1894, p. 207, pl. 2, figs. 3, 6, 7, 21, 28—32, 34—36.

„ *Hilgendorfi*, G. W. MÜLLER, 1890, p. 228, pl. XXV, fig. 9, pl. XXVI, figs. 1—3, pl. XXVII, fig. 30.

A closer examination of these species will probably make it necessary to widen somewhat the above diagnosis of the sub-genus.

As the type of this sub-genus I consider the form described below under the name *C. (V.) norvegica*. *Type.*

C. (Vargula) norvegica W. BAIRD.

? *Cypridina norvegica*, W. BAIRD, 1860a, p. 200; pl. LXXI, figs. 4, 4a—4d.
.. .. G. O. SARS, 1865, p. 104.
.. .. 1872, pp. 278, 286.
.. .. 1886, p. 74.
.. .. G. S. BRADY and A. M. NORMAN, 1896, p. 647; pl. LIV, figs. 7, 8; pl. LX, figs. 19—21.
.. .. G. O. SARS, 1899, p. 234.
.. .. O. NORDGAARD,* 1905, p. 182.
.. .. G. W. MÜLLER, 1912, p. 15.

Description: — Female: —

Shell: — Length, 3.3—3.65 mm. W. BAIRD specifies a length of 3.81 mm. (= 1,5 line); G. S. BRADY and A. M. NORMAN give a length of 4 mm. for this species. These authors do not give any information about the range of variation of the length. Length : height, about 1,4 : 1; length: breadth, about 1,75 : 1. Seen from the side the form varies somewhat, thought only slightly (figs. 1 and 2). It is oval with the greatest height at about or just behind the middle and the posterior part only very slightly larger than the anterior one. The dorsal and ventral margins are uniformly and rather boldly arched, the arcuation of the former somewhat stronger than that of the latter; both without corners joining the anterior and posterior margins. The rostrum is well and uniformly arched anteriorly, without any anterior corner; its ventral corner rather pointed. The rostral incisur is deep and narrow. The posterior part of the shell is broadly rounded with only a faint indication of a broadly rounded posterior corner somewhat below half the height of the shell or else it is rather strongly truncated (fig. 2). Seen from below (fig. 3) it is oviform with its greatest breadth somewhat behind the middle; the anterior and posterior ends are well rounded, the posterior somewhat broader than the anterior one. The surface of the shell is almost quite smooth with only an exceedingly faint indication of small cavities just within the anterior margin of the shell; in most cases this sculpture is scarcely distinguishable. There are no bristles on the surface. The pores of the surface are very difficult to distinguish. Seen from within (fig. 4): Medial bristles: On the rostrum there is an irregular row of rather short and most frequently bifurcated bristles directed slantingly forwards and upwards [about the same type as is reproduced for *C. (Doloria) levis*, fig. 2]; the place on which the ventral bristles of this row are fixed is not developed into a verruciform protuberance. In front of and behind this row there are a few scattered bristles. Along the ventral edge of the rostrum there is a great number of scattered bristles; most of these latter are of about the same type as the bristles in the row. Sometimes all the bristles on the rostrum are scattered without any arrangement in a distinct row; they also vary considerably in number. The two bristles near the inner edge of the rostral incisur are of about the same size as the bristles on the rostrum; they are bare or furnished with short, fine hairs

* G. O. SARS determ.

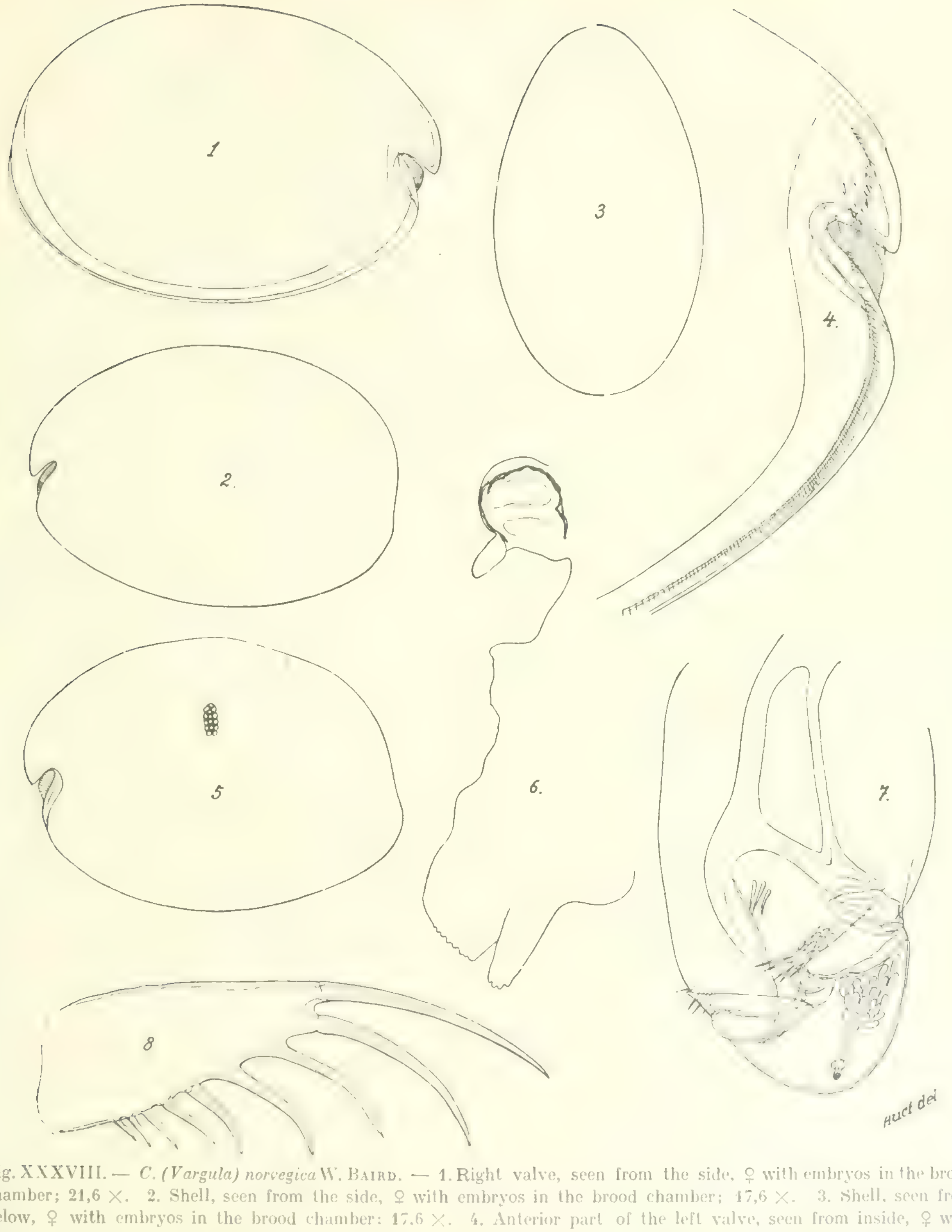

Fig. XXXVIII. — *C. (Vargula) norvegica* W. Baird. — 1. Right valve, seen from the side, ♀ with embryos in the brood chamber; 21,6 ×. 2. Shell, seen from the side, ♀ with embryos in the brood chamber; 17,6 ×. 3. Shell, seen from below, ♀ with embryos in the brood chamber: 17.6 ×. 4. Anterior part of the left valve, seen from inside, ♀ with embryos in the brood chamber; 47 ×. 5. Left valve, seen from the side, ♂: 19,5 ×. 6. Upper lip and the median eye and the rod-shaped organ, ♂; 62 ×. 7. Left penis, seen from inside, drawn as if it were semi-transparent; 147 ×. 8. Furca, the teeth of the claws are not drawn, ♂; 80 [illegible]. Specimens from [illegible].

and simple. Above these two bristles near the joining line there is a single, short, simple bristle. Besides these three there are in some cases one or a few bristles inside the incisur. The list behind the incisur is narrow, weakly undulating and has bifurcated bristles, situated very close together, of about the same type as those on the rostrum. Farther back the list has fewer and fewer bristles, half-way along the shell they are already very sparse and a little behind this point they stop almost entirely, though one or a few may be found. Within the posterior margin of the shell — where the list is somewhat broader than it is anteriorly — it has, however, rather numerous small, simple bristles, very difficult to verify, and it is also characterized here by pore-like formations similar to those reproduced for *C. (Doloria) levis* (see p. 228, fig. 3). On the part between the list and the margin of the shell — along both the posterior and ventral margins — bristles generally seem to be quite absent; sometimes, however, a few may be observed. The selvage is only broad along the posterior edge of the rostral incisur — the latter is quite filled by it — the rest of it is narrow and does not extend outside the margin of the shell. It has close, uniform and fine cross-striation, often rather difficult to distinguish, and is exceedingly finely serrated at the edge, almost smooth-edged. It is strongly calciferous, but thin and fragile.

First antenna: — The two bristles of the third joint are rather long, of about the same length as the following joint, the anterior one is fixed just proximally of the middle of the joint. The anterior bristle of the fourth joint is, as a rule, somewhat shorter, the posterior one somewhat longer than the fifth joint. The bristle of the sixth joint and the a-bristle of the seventh joint are of about the same length as the fifth joint, the latter bristle being generally somewhat longer than the former. The length of all these bristles varies somewhat, however. They all have short hairs. The sensory bristle of the fifth joint is generally not quite as long as the anterior side of the second to the fourth joints; sometimes it is only the same length as the second and third joints. Of its thirteen sensory filaments the proximal ones are rather long, attaining about a third to a half of the whole length of the bristle, and somewhat, though only slightly, thicker than the distal ones; the latter are rather short, the transition in length and thickness is, however, fairly gradual; all the sensory filaments are equally thick throughout the whole length; the proximal ones are furnished proximally with up to four exceedingly small, fine secondary spines, the distal ones are bare. Of the bristles on the seventh and eighth joints (fig. 16) the b-bristle is quite short, rather slightly longer than the a-bristle (and rather considerably shorter than the d- and e-bristles); along its proximal half it has four or five rather short sensory filaments. The c-, f- and g-bristles are rather long; the last-mentioned one, which is the longest, is about as long as the anterior side of the seven distal joints; of the two others the f-bristle is the shorter. The c-bristle has ten or eleven sensory filaments, the f-bristle has ten and the g-bristle has eleven. The sensory filaments on the b-, c-, f- and g-bristles are furnished anteriorly with some (from zero to six) short and rather strong spines. The simple sensory bristles d and e are about a third of the length of the c-, f- and g-bristles. Pilosity: The second joint is only sparsely furnished with short hairs, arranged in a few transverse rows on the anterior and posterior margins.

Second antenna: — Protopodite: About 1 mm. in specimens about 3,5 mm. long. The medial-distal bristle is about as long as the second joint of the endopodite,

and has short hairs. The exopodite (fig. 9) has about the following proportions between its joints:

I : II : III : IV : V : VI : VII : VIII : IX = 55 : 11 : 6 : 5 : 5 : 5 : 5 : 5 : 3.

In other words the first joint is somewhat longer than all the other joints together, the second joint has about the total length of the third and fourth joints. The bristle of the second joint is about as long as the five to seven following joints and is furnished with from about nine to thirteen powerful ventral secondary teeth. The proportion between the longest natatory bristles and the total length of the exopodite is about 13 : 10. These bristles have broad natatory hairs (about the same as in *C. (Macrocypridina) castanea*; see fig. 12 of this species). The end joint has four bristles, of which the dorsal one is quite short, attaining about the total length of the three or four distal joints, with short, fine hairs or almost naked. The third to the ninth joints have strong and rather long conical basal spines, the proximal ones somewhat shorter than the distal ones, the one on the third joint being specially short in comparison with the others. At the base of the bristle of the second joint there is a series of short and moderately strong spines. Endopodite (fig. 10, ♂ = ♀): This is comparatively well developed, elongated and triple-jointed. Its first joint has proximally a group of four bare or almost bare bristles, three of which are subequal, rather short, scarcely attaining half the length of the fourth; the latter is about the same length as the second or the second and third joints. Somewhat distally of this group there is a single bristle with short hairs, which is generally somewhat longer than the longest of the four bristles mentioned. The second joint has distally a single bristle, with short hairs or almost naked, which is somewhat longer than the end joint. The bristle of the end joint is about twice as long as the endopodite.

Mandible (fig. 11): — Protopodite: The endite on the coxale has very numerous spines; it is weakly bifurcated, the two distal points are considerably stronger than the other spines of the process; between the two distal points, which, unlike the other spines, are furnished with a few weak secondary teeth, there is a low, powerful wart. Basale: This has seven bristles ventrally: two a-bristles, one b-bristle, two c-bristles and two d-bristles. The a-bristles are somewhat different in length from each other, the longest one being about as long as half the height of the joint; the b-bristle is short; one c-bristle varies somewhat in length and is about as long as the height of the joint, the other is short; the shortest d-bristle is somewhat shorter than the longest c-bristle, the longest d-bristle is about as long as the endopodite. Of the three dorsal bristles on this joint the proximal one is fixed somewhat in front of the middle of the joint and is about half its length; of the two distal bristles one is about as long as the proximal dorsal bristle, the other about double its length; all three have short hairs. Exopodite: This is about as long as the dorsal side of the first endopodite joint or somewhat longer. Of its two bristles, both furnished with short hairs, one is about as long as the exopodite, the other is somewhat longer. Endopodite: The longest of the four ventral bristles on the first joint has some irregular wreaths of long, stiff secondary bristles and has short hairs distally, the others have short hairs. Second joint: On the anterior side there are from eleven to fourteen more or less long bristles with short, fine hairs; the longest of those that are fixed distally reach the end joint with their points. There are, in addition, from

fourteen to eighteen short cleaning bristles, situated more or less irregularly, all finely pectinated distally. On the posterior side of this joint, distally of the middle, there are two rather short, smooth bristles of about the same length as each other, one situated somewhat distally of the other, and near the posterior distal limit of the joint two other bristles of the same type as the former, situated close to each other, are to be found; of these the medial one is somewhat, though only rather slightly, more powerful than the lateral one. Of the seven bristles of the small end joint (fig. 12) the two middle claw-like ones are only about a quarter of the length of the second endopodite joint. Of the two anterior ones, both of which are somewhat shorter than the two former ones, the medial one, which is the longer one, is somewhat claw-like, the lateral one is rather weak. Of the three posterior bristles the one situated most posteriorly is very short and weak, the two others are subequal, somewhat longer than the two anterior ones and about as strong as the weaker of these. The two main claws have a few weak secondary teeth posteriorly, proximally of the middle, the other bristles of the end joint are smooth. Pilosity: There are short, stiff hairs dorso-distally on the first endopodite joint and transverse groups of short hairs posteriorly on the second endopodite joint.

M a x i l l a: — P r o t o p o d i t e (fig. 17, ♂ — ♀): The first endite has ten or eleven (usually eleven) powerful, subequal, moderately long bristles, furnished with an abundance of long, stiff secondary bristles placed close together; there are somewhat fewer of these secondary bristles on the outer bristles than on the inner ones. On the three inner ones the secondary bristles continue as far as the points of the bristles, on the others they stop a short distance from the points. Three of the latter bristles are trifurcated distally; four or five have a single powerful point, the latter being generally without distal secondary teeth. The second endite has five bristles (only on one specimen were there found six bristles on the maxilla of one side). They are all rather strong, of moderate lengths, subequal, the inner one being, however, a little shorter than the others, and all of about the same type, with a moderate number of long, stiff secondary bristles at the middle and rather thinly pectinated distally; there is often, however, no pectination on the inner bristle. The third endite has also five distal bristles, rather powerful and of moderate lengths, the outer one being slightly longer than the inner ones. The four outer ones are furnished at the middle with a moderate number of long, stiff bristles and are finely pectinated distally; the inner one has short, fine hairs or is almost naked. The bristle situated proximally on the outside of the last-mentioned process has short and exceedingly fine hairs or is bare and is not quite as long as the outside of this process. The dorso-distal bristle on the coxale is about as long as the outer of the distal bristles on the third endite. On the boundary between the basale and the first endopodite joint there are only two bristles, the bristle that is found in most of the other species of this sub-family on the anterior side of the palp is quite absent in this form. Of these two the one that is fixed close to the exopodite is somewhat longer than the bristles of the exopodite and has sparse long secondary bristles at the middle, distally it is almost bare. The one that is fixed on the inside of the palp is almost bare and quite short, only about a third of the length of the former (the last-mentioned bristle seems sometimes to be absent). E x o p o d i t e: Its three bristles are subequal, somewhat longer than this branch. The distal one of them has short hairs, the two others are plumous.

Fig. XXXIX. — *C. (Vargula) norvegica* W. BAIRD. 9. Distal part of the exopodite of the right second antenna, seen from outside, ♀; 160 ×. 10. Endopodite of the second antenna, ♂; 125 ×. 11. Mandible, seen from inside, ♀; 160 ×. 12. Distal part of the mandible, seen from outside, ♀; 392 ×. 13. Distal part of the mandible, seen from inside, ♂; 392 ×. Specimens from Lofoten.

Endopodite (fig. 18, ; —): First joint: Its posterior distal cutting edge projects but slightly and is only rather weakly lobed; it varies in form. Distally-anteriorly on this joint there are two rather long bristles, the anterior one of which is somewhat longer than the other; both, especially the longer one, furnished with close, long, fine hairs. Distally-posteriorly this joint has three or four bristles, one rather long and powerful and very strongly pectinated, the others somewhat different from each other in length and about half as long as the former bristle or somewhat shorter, rather weak, bare or with short, weak secondary teeth. The end joint is rather strongly chitinized and is usually furnished with thirteen bristles, in exceptional cases a somewhat larger number being found: Four a-bristles (exceptionally five were found) of moderate lengths and strength, bare or furnished sparsely with short, fine secondary bristles. Three b-bristles, the anterior one of which is rather powerful, of moderate length and very strongly pectinated; the two others are subequal and somewhat shorter and weaker, the anterior of them rather strongly pectinated distally, the other furnished distally with rather few, but very powerful secondary teeth. Three c-bristles (four c-bristles were found on the maxilla of one side in only one specimen), the two posterior of which have about the same type and size as the anterior b-bristle, the anterior one being quite short and weak, in most cases armed with a few secondary teeth. Three d-bristles, somewhat more powerful than the other bristles of this joint, of moderate lengths, the posterior one somewhat longer than the others. The posterior d-bristle is of about the same type as the anterior b-bristle, the two others are armed at the middle with a moderate number of very powerful secondary teeth. The bristles of this joint all varied somewhat with regard to the shape and number of the secondary teeth. Pilosity: On the first endopodite joint there are transverse rows of short, fine hairs.

Fifth limb: — Protopodite: The first endite (fig. 19) has eight bristles, all of the same type, powerful masticatory bristles, furnished with exceedingly numerous long, powerful secondary bristles, arranged in more or less distinct wreaths. Of these bristles nos. 2, 4, 6, 7 and 8, counting from the anterior side of the limb, are of moderate lengths; the two first-mentioned ones are subequal and somewhat longer than the three others, which are also subequal. Bristles nos. 1, 3 and 5 are rather considerably shorter than the five mentioned above. In one specimen nine bristles were observed on this endite on the fifth limb of both sides, the extra bristle being situated close to bristle no. 5 and being somewhat shorter than this bristle. The five inner bristles of the second endite (fig. 20) are powerful and of moderate lengths, the anterior and the posterior ones being somewhat longer and more powerful than the others; they are all furnished with one or a few wreaths of long, powerful secondary bristles. Nos. 1 and 2, counting from the anterior side of the limb, are furnished distally with a few rather powerful secondary teeth, no. 3 is finely serrated distally, nos. 4 and 5, especially the latter, are strongly pectinated distally. The single bristle on the anterior side of this process is short, somewhat varying in length, often furnished with short hairs, sometimes with a few long secondary bristles. The seven bristles of the third endite (fig. 21) are all powerful, especially the posterior one, and of moderate lengths, nos. 4, 5 and 6, counting from the anterior side of the limb, being somewhat shorter than the others. All except the three last-mentioned ones are furnished at the middle with one or a few irregular wreaths of long, powerful secondary bristles.

Fig. XL. — *C. (Vargula) norvegica* W. Baird. — 14. Distal part of the left first antenna, seen from outside, ♂; 96 ×. 15. Proximal ramus of the b-bristle of the male first antenna; 504 ×. 16. Distal part of the left first antenna, seen from inside; all the bristles broken; the dotted lines mark the lateral boundaries of the joints; ♀; 392 ×. 17. The endites of the maxilla, ♂; 200 ×. 18. Distal part of the endopodite of the right maxilla, seen from inside, ♂; 240 ×. Specimens from Lofoten.

Bristles nos. 1, 2 and 4 are rather strongly pectinated distally; on the two latter ones the points seem, however, to be always smooth. Bristles nos. 3 and 5 are finely serrated distally. Bristles nos. 6 and 7 are bent somewhat into an angle distally of the middle and very strongly pectinated distally, especially the latter one. The distal chitinous tooth of the protopodite is of moderate length, and irregular in form, varying to some extent. Epipodial plate: This has from about fifty-five to sixty bristles, all with long hairs almost right out to the points. The exopodite is five-jointed (fig. 22): First joint: The main tooth has seven constituent teeth all well defined proximally; the secondary teeth on the latter are of about the same type as is reproduced in the adjoining figure, but there is, however, some variation. The bristle near the main tooth on the posterior side of the joint is about as long as the anterior constituent tooth of the main tooth and is furnished at the middle with a wreath of long, stiff secondary bristles and a few secondary spines; distally it is bare. On the anterior side of this joint there are usually four bristles; sometimes, however, five or six were found. Of these four bristles three are situated in a close row near the main tooth, the fourth at a short distance from these three, farther out on the joint. The two nearest the main tooth are of about the same type as each other, subequal, rather long and powerful, strongly pectinated distally and furnished at the middle with a number of long, stiff secondary bristles. The two others, of the same type as each other, are subequal, somewhat shorter than the two former ones, and have at the middle long and rather soft secondary bristles, and short, fine hairs distally. In those cases where a greater number of bristles were found on this joint, the extra bristles were of the same type as the two last-mentioned bristles and were situated between these. Second exopodite joint: This has four or five, usually four, rather powerful a-bristles, equipped rather strongly, eight b-bristles and one c- and one d-bristle. The c-bristle is of moderate length, either with short hairs or with short hairs distally and furnished at the middle with some long hairs. The d-bristle is of about the same type and length as the outer anterior bristle on the first exopodite joint. The inner and outer lobes of the third joint are rather small. The inner lobe is furnished distally with two or three rather strong and moderately long bristles, with short hairs and somewhat different in length from each other. Posteriorly-proximally there is on this lobe a moderately long bristle, with long, soft hairs at the middle and short ones distally. The outer lobe of this joint has two moderately long bristles distally; these are either both of the same type, with long hairs at the middle and short ones distally or else one of them is of this type and the other has only short hairs. On one specimen three distal bristles were found on this lobe on the limb of one side. The fourth exopodite joint, which is rather large and square, has distally and inwards four or five rather short and weak bristles of somewhat different lengths and with short, fine hairs, and somewhat proximally of these there is a group of two or three similar bristles; the hairs on the latter bristles are, however, somewhat stronger than those of the former. The end joint is quite small, fixed distally and outwards on the preceding joint, and is moved by special muscles. It has two or three, usually two, distal bristles of moderate lengths with short hairs. Pilosity: The outer lobe of the third exopodite joint and the two distal exopodite joints are partly furnished with fine hairs, placed close together. The end joint has short, stiff hairs distally.

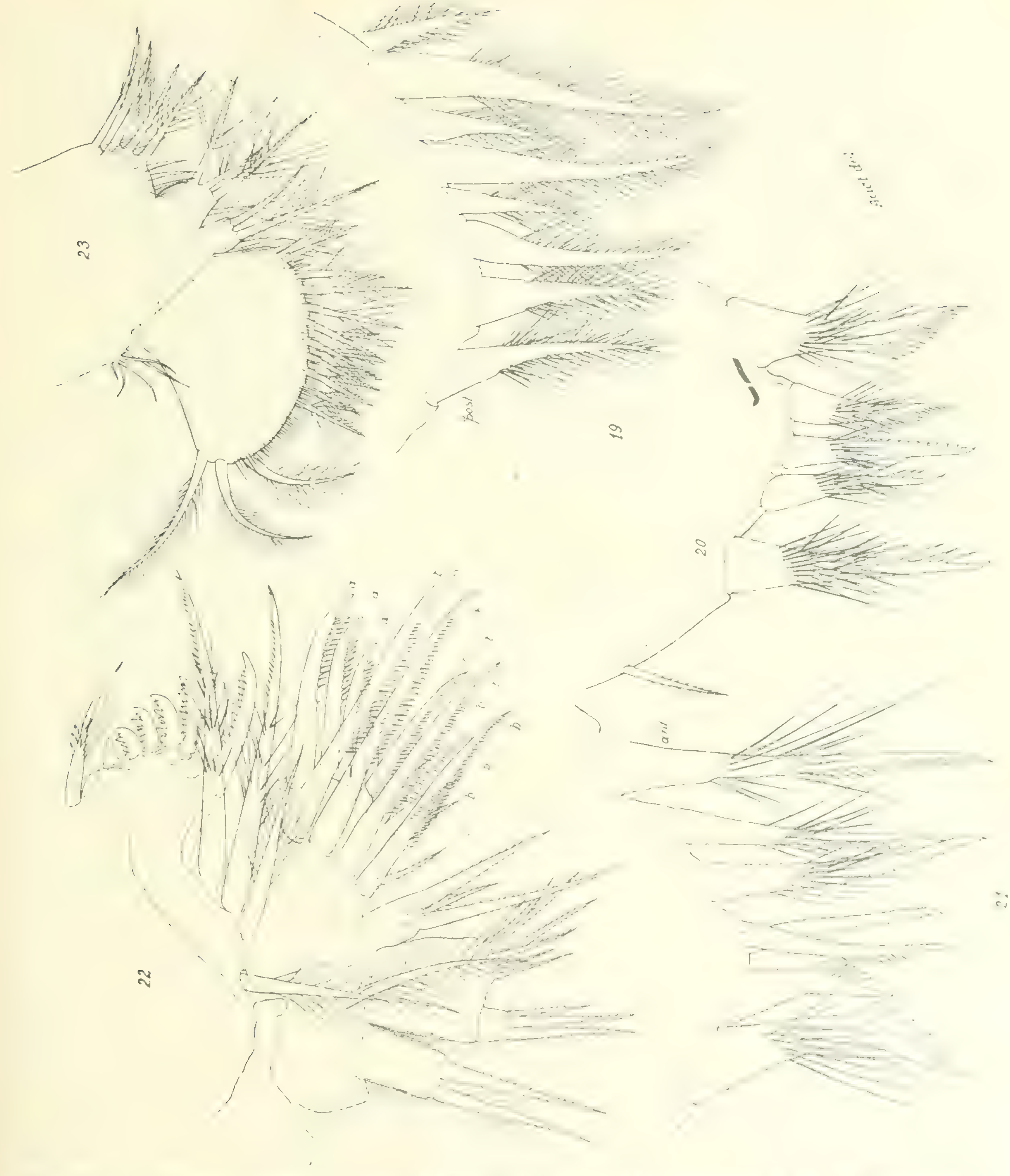

Fig. XLI. — *C. (Vargula) norvegica* W. Baird. [illegible] 19. First endite of the protopodite of the fifth limb; [illegible] 20. Second endite of the protopodite of the fifth limb; 440 ×. 21. Third endite of the protopodite of the fifth limb; 440 ×. 22. Exopodite of the right fifth limb, seen from the anterior side; 224 ×. 23. Right sixth limb, seen from outside; 120 ×. Specimens from Lofoten.

S i x t h l i m b (fig. 23): — P r o t o p o d i t e: The first endite has one or two rather long and powerful distal bristles, furnished with a few wreaths of long, stiff secondary bristles, and, in addition, two short, plumous medial bristles. Second endite: This has two or three rather long and powerful, subequal distal bristles, with long, stiff secondary bristles at the middle and short hairs or else bare distally, and, in addition, usually four rather short, plumous medial bristles; in one specimen five medial bristles were observed on one limb on this endite. Third endite: This has three rather long and powerful distal bristles, the middle one of which is somewhat shorter than the two others; all of them are of about the same type as the distal bristles of the second endite; this joint has, in addition, one medial bristle of about the same type and length as the middle distal bristle of this process. The e p i p o d i a l a p p e n d a g e of the protopodite is represented by five short, bare or almost bare bristles. E x o p o d i t e: First joint: The endite has two distal bristles and one medial bristle; these are of about the same type as the bristles on the preceding endite. Second joint: This has rather numerous bristles, all situated very near the ventral margin; with a pronounced gap between the posterior bristles and the others. The three posterior bristles — on one specimen they were four on the limb of one side — are rather long and have long and soft hairs right to or almost right to the point. The rest, from eight to twelve, the number varying from specimen to specimen and also on the right and left limb of the same animal, are of moderate and somewhat different lengths, most frequently all of the same type, furnished at the middle with long, stiff secondary bristles, arranged to some extent in the form of wreaths, and with short hairs distally. Pilosity: The inside of this limb has rather close, short, fine hairs; along the ventral margin of the second exopodite joint there is a series of short, stiff hairs laterally.

S e v e n t h l i m b (figs. 24—26): — This is comparatively short, not quite half the length of the shell. (On several specimens whose shells were from 3,3 to 3,4 mm. long this limb had a length of from 1,3 to 1,4 mm.) Cleaning bristles: From nine to eleven ventral bristles and from eight to eleven dorsal ones are situated very close together distally. The relative lengths of these bristles vary to some extent; in most cases, however, the most distally situated of the ventral ones is of moderate length, the next distal one is relatively long, the rest diminish somewhat in length, though rather irregularly, the more proximally they are situated, the proximal ones being rather short; among the dorsal ones the distal ones generally are relatively long, the proximal more or less short. Proximally of these bristles, scattered irregularly, there are from nine to thirteen ventral bristles and from ten to fourteen dorsal ones; the lengths of these also vary somewhat, but in most cases, however, they are subequal and of moderate length. The cleaning bristles are furnished with from one to six bells cut off transversally distally; the tongue of the distal bell is also cut off rather transversally distally (cf. fig. 25); proximally of the bells the cleaning bristles are smooth. The end comb consists of from seven to eleven rather long distal teeth, rather pointed distally, decreasing somewhat in length the more proximally they are situated, and, in addition, of from three to six considerably shorter proximal teeth on both sides. The cavity dorsally of the end comb is rather deep; its dorsal wall is furnished with an unpaired, rather high and narrow, distally rounded, chitinous peg,

almost or quite bare, but apart from this it has no appendages at all. There is no special muscle for closing this cavity.

F u r c a: — This has nine claws, somewhat more powerful than those shown in the accompanying figure 8 of the male furca, all decreasing rather uniformly in length the more proximally they are situated, with the exception of claw no. 3, which is somewhat, though

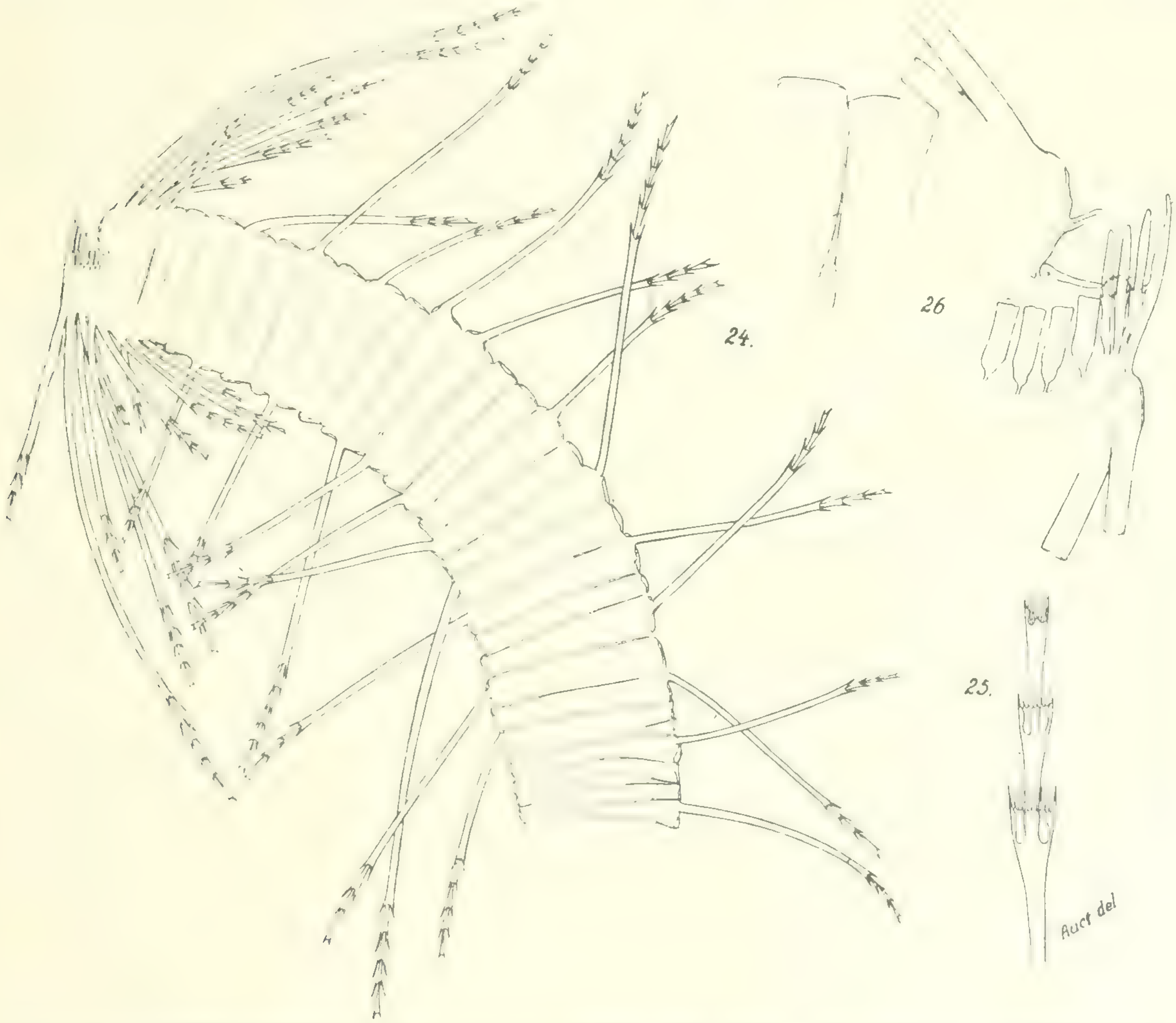

Fig. XLII. — *C. (Vargula) norvegica* W. BAIRD. ♀. 24. Seventh limb; 192 ×. 25. Some of the distal bells of a cleaning bristle of the seventh limb; 1240 ×. 26. The point of the seventh limb; 680 ×. Specimens from L o f o t e n.

slightly, shortened and weakened; it is about as long as or slightly shorter than claw no. 4. All the claws are well defined from the lamella except claws nos. 2 and 4, which are quite joined to it. Proximally of the claws the furca is smooth.

U p p e r l i p (fig. 6, ♂ = ♀): — The upper glandular field is of moderate size; the two lower paired ones are small and situated distally on two long tusk-like processes. The protuberance dorsally of the upper lip is rather low and broad.

The rod-shaped organ is blunt distally.

The lateral eyes are small, with about nine or ten ommatidia.

Male:

Shell: Length, 3,1—3,3 mm. Length : height, about 1,4 : 1. Seen from the side (fig. 5) it is of about the same type as that of the female, differing especially by the posterior part of the shell being somewhat lower — in some cases rather considerably lower than is shown in the accompanying figure — the anterior part of the shell is even somewhat, though only slightly, larger than the posterior one. The dorsal margin is well arched anteriorly, in some specimens somewhat more than is shown in the accompanying figure; sometimes it has an indication of a low hump in the middle as in the adjoining figure, in most cases, however, it is evenly arched. The posterior-ventral corner is rather better developed than in the female. In other respects it agrees with the female shell.

First antenna (fig. 14): — This is somewhat longer than in the female; the proportion between the length of the anterior side of the seven distal joints in the male and in the female is about 35 to 30. The end joint seems to be somewhat less well defined than in the female. Bristles of the seventh joint: The b-bristle is about as long as the anterior sides of the second to the fourth joints; in most cases with only three filaments, all with suctorial organs. The proximal one of these has distally of the suctorial organ a powerful, rounded verruca (cf. fig. 15). The two others are long and powerful, the distal one extending considerably beyond the point of the bristle and having five (in one case there were six on the distal one) suctorial organs, proximally of which a small verruciform process is found. In one case an additional extremely short and bare filament was observed just distally of the distal one of these filaments. The c-bristle is about as long as the anterior side of the seven distal joints of the antenna; it has ten filaments, of which the two proximal ones and the sixth one (counting from the base) are furnished with suctorial organs; the position of the distal filament that has suctorial organs may, however, vary; the three filaments with suctorial organs are of the same type as the corresponding filaments on the preceding bristle. Of the bristles of the end joint bristles f and g are only very slightly longer relatively than these bristles in the female; they have the same number of filaments, ten and eleven respectively, as these bristles in the female. In other respects this antenna shows great agreement with that of the female.

Second antenna: — This agrees very closely with that of the female, with the sole exception that it is somewhat more powerfully developed; the exopodite was, for instance, equally long in a male with a shell 3,2 mm. long as in a female with a shell 3,5 mm. long. The proportion between the length of the natatory bristles in the male and female is about three to two.

Mandible: — This is very similar to that of the female. The medial of the two posterior-distal bristles on the second endopodite joint is, however, much more powerful than the lateral one (fig. 13), attaining almost to the strength of the two middle main claws on the end joint; the lateral one of these two bristles is about the same as in the female. There is also some difference to be observed between the two sexes with regard to the shape of the claws on the end joint (cf. figs. 12 and 13); all the bristles of the end joint are quite bare.

The maxilla and the fifth and sixth limbs are very like those of the female.

Seventh limb: — This is very like that of the female. The following numbers of cleaning bristles were observed: from nine to thirteen ventral ones and from eight to eleven dorsal ones situated close together distally; proximally of these from five to seven ventral ones and from eight to ten dorsal ones scattered about. The equipment of these bristles was similar to that of the female. The end comb sometimes seemed to be slightly weaker than in the female.

Penis (fig. 7): — This is of the fundamental type for this sub-family; for details see the accompanying figure; the number of bristles varies to some extent.

Furca (fig. 8): — As in the case of the female, it has nine claws; in the male, however, these are somewhat more slender; the second, third and fourth claws are joined to the lamella; no. 3 is somewhat weakened. The equipment of the claws is perhaps a little weaker than in the female.

The upper lip and rod-shaped organ are about the same as in the female.

The lateral eyes have from fourteen to sixteen ommatidia and are thus somewhat larger than in the female.

The back of the body is somewhat folded transversally.

Remarks: — The original description of *Cypridina norvegica* W. BAIRD is, as is seen from the above list of synonyms, to be found in the Proceedings of the Zoological Society of London, 1860, p. 200. G. S. BRADY and A. M. NORMAN, 1896, and G. W. MÜLLER, 1912, give it as being from the Annals and Magazine of Natural History, 1860, p. 139. This is, however, incorrect, inasmuch as the treatise entitled „On some new species of *Cypridina*", to which these authors obviously refer, is only a reproduction of the original treatise. It is printed under the heading „Proceedings of Learned Societies, Zoological Society". Unlike the original treatise, however, it is not accompanied by any illustrations. *Remarks about the original description.*

The description in question is very short and is given in very general terms, without any characteristic details being produced. Only the shell is dealt with. The accompanying figures are also of such a nature that certainty of identification is impossible. Thus in 1912 G. W. MÜLLER quite justly denotes G. S. BRADY's and A. M. NORMAN's identification as uncertain by adding a query.

The species in question was described from a specimen caught on „the coast of Norway". Only one other species of this sub-genus is described from this region, namely *C. (V.) megalops* G. O. SARS. As this region may be said to be rather well investigated — at least as far as forms as relatively large as the two mentioned ones are concerned — and as *C. (V.) norvegica* and *C. (V.) megalops* are so essentially different from each other with regard to the form of their shells that there may be no risk of confusing them, I have decided, in spite of the incompleteness of W. BAIRD's original description, to identify my form described above with this species of BAIRD's. *Identification.*

According to the statement of W. BAIRD himself the type-specimen of this species is preserved in the British Museum. If, however, this specimen is no longer to be found and if new species with a habitus agreeing with that of *C. (V.) norvegica* are discovered on the coast of Norway, then, of course, this species of BAIRD's will have to be deleted from the list of the identifiable species and a new name given to the form described by me above.

The form that is dealt with by G. O. SARS, 1865, p. 104, is also rather incompletely described. As, in addition, the description is not accompanied by illustrations, this form should really be denoted as unidentifiable. The description given by me above is, however, from specimens — found at Lofoten — that this investigator had determined to be *Cypridina norvegica*. For this reason I have considered it best to look upon all the information given by this writer about *C. norvegica* as really referring to the species dealt with here, although all the separate statements have not been tested by me.

Whether the form described by G. S. BRADY and A. M. NORMAN, 1896, p. 647, under the name of *Cypridina norvegica* is to be considered as identical with the species dealt with above, is not quite certain, at least if attention is only paid to the description and figures. Differences are found both in regard to the shell and the furca and limbs, as is soon shown by even a superficial comparison between the two descriptions. In spite of this I have included this form as a synonym of the species dealt with above, because G. S. BRADY and A. M. NORMAN have, if we judge from the text, based their description on specimens from the coast of Norway and because I knew that these writers often take very little care about the correctness of their details.

On the other hand it did not seem proper to me to include as synonyms *Cypridina norvegica* A. M. NORMAN, 1868, p. 439, 1869, pp. 256, 257, 260, 295, 1891, pp. 119, 121; G. S. BRADY and D. ROBERTSON, 1872, p. 70 and C. H. OSTENFELD and C. WESENBERG-LUND, 1909, p. 113, because these statements were not accompanied by any figures or information at all to verify them.

The reduction of the third furcal claw, though only slight, ought perhaps to be specially mentioned; it has a certain interest because it is just this claw that is exceedingly reduced in another species of this sub-genus, *V. Vanhöffeni* (G. W. MÜLLER).

Sexually mature males and females with embryos were found both on the 18th of May and the 5th of August on the West Coast of Sweden and between the 3rd and 11th of September in Trondhjem Fjord.

Specimens from different regions.

There was no difference in size between the specimens from northern regions, the Lofoten Islands, and those from more southern places, Koster Fjord. From both localities comparatively large as well as comparatively small specimens were recorded.

Parasites of this species.

Especially conspicuous was a parasitic I s o p o d, *Cyproniscus cypridinae* (G. O. SARS), concerning which I will only quote G. O. SARS's statement, 1899, p. 235: „I have not infrequently found this interesting form off the Lofoten Islands and at Bodö and Selsövig, infesting *Cypridina norvegica* BAIRD. . . . . The parasite, when fully developed, is easily observable through the semipellucid valves of the *Cypridina*, always occupying the place where otherwise the ova and embryos of the latter are carried during their development. Occasionally the parasite also occurs on male *Cypridinae*; but in no instance have I found it in this case fully developed, and it is very probable that under such circumstances it does not ever reach maturity." This parasite occurred on about 30 per cent. of the specimens of the above species recorded from the Trondhjem Fjord and the Koster Fjord, but curiously enough no specimen of it was found on the specimens of *Cypridina* from the Lofoten Islands that I have examined.

Phenomena of parasitism.

The specimens of this species that are mentioned below as having been caught in Trondhjem Fjord were all found in the cloaca and uterus of *Etmopterus spinax* (LINNÉ). According

to information received by me from the collector, Fil. lic. HJ. ÖSTERGREN, all the specimens were quite active and emitted an intensely phosphorescent light. This fact, like the circumstance that a number of specimens were found in the uterus, decidedly indicates that they had not been swallowed by the fish as food, i. e. that they had not passed through the alimentary canal, but it must be assumed that they penetrated actively into the fish, where they lived on waste products and, at least in the uterus, as parasites.

Curiously enough all the twenty-five specimens were found in a single specimen of the above-mentioned fish, although no less than about a hundred specimens of the latter were investigated (according to information received from Fil. lic. ÖSTERGREN). As I have carefully investigated myself about sixty specimens of this *Etmopterus* species caught in Trondhjem Fjord without finding a single specimen of *Cypridina* and Fil. lic. O. NYBELIN has investigated about 150 from the same fjord with a similar negative result, this habitat must perhaps be regarded as a rare one, in spite of the curiously large number of specimens found in one fish. – It ought perhaps to be pointed out that *C. (V.) norvegica* seems to be very rare in Trondhjem Fjord: „Sparsim in sinu Nidarosiensi" (G. O. SARS, 1865). (Is it possible that all these 25 specimens are the offspring of one and the same fertilized female which have left the mother after the latter had penetrated into the fish?)

I was unable to discover any morphological differences between free-living specimens and the parasitic specimens, although they were subjected to a very minute examination.

There may be an increased interest attached to this find because this is not the first nor the only time that a Cypridinid has been found under conditions that seem to indicate a certain tendency to parasitism.

The first mention of a case of this sort in the literature is to be found in O. G. COSTA's work in 1847, p. 6. Here we find the following statement: „Dopo la pubblicazione della Memoria . . dissecando una *Scorpaena scrofa*, trovammo tutta la cavità addominale, o meglio il peritoneo in ogni punto attaccato da questo ostracode parassito, che a primo sguardo presentavasi come di glandolette bianche di cui pareva disseminato il cavo addominale. Noi potemmo trarve 120 di tutte le grandezze, niuno uguagliando però i precedenti ospitanti nell' Ofisuro. La qual causa rafferma essere propria una tale specie del Mediterraneo, e vivere abitualmente parassita su i pesci."

The latter find is mentioned in the same treatise, p. 1. Here we find that a Cypridinid, presumably the same species as in *Scorpaena scrofa*, i. e. *Cypridina mediterranea*, was found on the body of a *Ophisurus* „Noi trovammo nel corpo di un Ofisuro".

The next find is mentioned by A. BRIAN in a short essay on parasitic *Crustacea* (1909). In this we find that a number of specimens of *Cypridina mediterranea* (?) were found in „seni e canali frontale" of a fish *Coryphaena hippurus*. The length of these specimens was only 2.5 mm., which suggests that they were not sexually mature. With regard to this case the author writes as follows: „Questa specie d'ostracode non è da ritenersi parassita per quanto trovata su di un pesce. Esse vive liberamente e non si tratta qui che di un semplice caso di commensalismo." In other words this author considers this habitat quite an accidental one, as I did above.

Still more interesting is the statement about the parasitic occurrence of species of this sub-genus that is given by CH. B. WILSON, 1913 (a preliminary note 1911, p. 22). This author describes (p. 269) a new species called *Cypridina parasitica*, which is certainly unidentifiable as a species, but without doubt belongs to the same sub-genus as does the species that I have dealt with above. This form seems to have been discovered as a parasite in no less than five cases: „Five lots of this ostracod were obtained in all; two of these were taken from the gills of two hammer-head sharks, *Sphyrna zygaena*, on July 9, and include about 50 specimens each . . . The third lot contains a single specimen found on the gills of *Epinephelus adscensionis*, August 9. . . . The fourth lot contains three specimens taken from the gills of a jack, *Caranx crysos*, August 1. The fifth lot contains 12 specimens and was obtained from the nasal tubes of the hammer-head shark on June 17."

Whether all these finds given by WILSON really refer to a single species is anything but certain, at least if we are to judge from the superficial way in which the species in question is described and reproduced. A comparison between the two reproductions of the furca given in pl. 53, figs. 303 and 311 is even decidedly against such an assumption.

On the same page on which this information is found WILSON gives the following details about these finds. „That the presence of these ostracods on the fishes' gills was not accidental is abundantly proven by the following considerations: First there were too many of them; one or two or half a dozen might be washed on to the gills of a fish accidentally, but not 40 or 50. Again they were arranged altogether too regularly; in the space between the bases of two adjacent filaments and in contact with the gill arch, there was always a single ostracod, its long diameter at right angles to the gill arch, so that its anterior end projected slightly on one side between the filaments, and its posterior end on the other side. — Furthermore the tissues of each filament where they came in contact with the shell of the ostracod, were hollowed out in the center and slightly raised around the edges, thus forming a sort of pocket, which held the ostracod securely in place so that it could be removed only with a pair of forceps. This of course is absolute proof that the ostracod was not washed in temporarily, but that it had remained in position long enough to produce this effect on the tissues. In view of such conditions these ostracods may fairly be called parasitic. While it is impossible to see how they can draw any blood from the fish's gills, yet they certainly share the oxygenated water with which the fish keeps its gills supplied, and they get their food in some way while there. For food they may devour anything that the water contains and brings to them, they may eat scraps of the fish's food that come their way, or they may feed on the slime with which the fish's gills are covered. It is impossible to determine at present just what does constitute their diet."

No adaptation for parasitism of one kind or the other can be discovered in the form in question — at least if we are to judge from WILSON's description and figures; on the contrary this species must be said to have the structure that is typical for free-living forms of this genus. Accordingly it seems to me doubtful whether we are concerned in this case, contrary to the two preceding ones, with a (or several) exclusively parasitic form or forms.

ALFRED RAMSCH, in his work of 1906, p. 384, rejects O. G. COSTA's assumption that we have to deal with parasitism in the case quoted above, put forward by O. G. COSTA*. He points out that he had himself often come across different forms of large Ostracods in *Pagellus* both beneath the gill-cover and in the stomach; all the specimens so found were, however, dead. He writes l. c.: „Sie dienen den Fischen zur Nahrung und gelangen mit dem Atemwasser an die Kiemen oder finden sich gelegentlich im Darmtraktus. Ihr angebliches Vorkommen in der Abdominalhöhle möchte ich wohl als eine zufällige Erscheinung auffassen."

This idea of A. RAMSCH's seems to be incorrect. It is true that O. G. COSTA does not give any information as to whether the specimens found by him were alive or not at the time they were caught, but all the evidence is in favour of their being parasitic specimens. Of course this does not prevent O. G. COSTA's theory that we are concerned with an exclusively parasitic species from being incorrect.

From the cases put forward above one may perhaps draw the conclusion that within the sub-genus *Vargula* there exists a certain „tendency" towards a parasitic life. One may perhaps say that it is the first groping attempts towards the carrying out of this tendency that have been just brought to our notice.

It may be objected here that the word „parasitism" ought not to be used for these cases. This form of life ought rather perhaps to be called „commensalism", as has already been done by A. BRIAN. As a matter of fact we are probably dealing with a case which is on the boundary between these two phenomena; both commensalism and real parasitism certainly exist; the question as to which term is to be used before the problem has been investigated more closely is of minor importance.

Relation to C. (V.) antarctica.

If we try to determine this species according to the scheme of the genus *Cypridina* given by G. W. MÜLLER, 1912, p. 10, we find as follows: The furca has nine claws, the third of which is more than half the length of the second; the rostral incisur of the shell is well developed; the length of the shell is less than 4 mm.; the upper lip has two large tusk-like processes — „Mit 2 hauerartigen Fortsätzen hinter den anderen Drüsenmündungen"; the second and fourth furcal claws are joined to the lamina. — It is, however, not *Cypridina norvegica* we arrive at — as, on account of the incomplete description of this species, it could not be included in this examination scheme — but an antarctic species, *Cypridina antarctica* G. W. MÜLLER.

A close investigation of the description of the last-mentioned species — G. W. MÜLLER, 1908, p. 84 — shows that we are dealing with a form closely allied to *C. (Vargula) norvegica*. — In order to be able to undertake a more detailed comparison between these two forms I wrote to Professor G. W. MÜLLER, who was kind enough to send me a sexually mature female of the antarctic form and it is on this material that the supplementary description given below is based.

Habitat: — Coast of Norway:

Lofoten Islands: 1 mature male, 2 mature females and 3 juvenes; coll. unknown; R. M. S. 155. Skarnsund, Trondhjem Fjord; in a specimen of *Etmopterus spinax* (LINNÉ): 5 mature males, 12 mature females and 8 juvenes; coll. HJ. ÖSTERGREN; R. M. S. 156 and 157.

* „Vollkommen im Irrthum ist jedoch COSTA, wenn er behauptet, daß *Cypridina mediterranea* parasitisch in Fischen lebe."

Färne Fjord; on a muddy bottom: 2 mature females; coll. v. YHLEN; R. M. S. 158. Kristiansund: 55 specimens, mature males and females and a few larvae of different stages; coll. W. LILLJEBORG, U. Z. M.

West coast of Sweden:

St. Sneholmen, Koster; at a depth of about 150—200 m.; on a muddy bottom; on several occasions: 4 mature males, 20 mature females and a few larvae of different stages; coll. J. G. ANDERSSON and C. W. S. AURIVILLIUS; R. M. S. 159—161, U. Z. M.

Type-specimen of the new description, on slides, R. M. S.

Distribution: — West coast of Norway.

Out of Norway it has only been recorded once: lat. 71° N., long. 18° W. (G. O. SARS, 1886). — With regard to A. M. NORMAN's statement (1869) that it was captured at the Shetland Islands etc. see above p. 262.

C. (Vargula) antarctica G. W. Müller.

Cypridina antarctica, G. W. MÜLLER, 1908, p. 84; pl. IV, figs. 4, 11—13; pl. V, figs. 9—12.
„ „ „ „ „ 1912, p. 12.

Description: — See G. W. MÜLLER, loc. cit.

Supplementary description: — Female:

Shell: — Seen from inside (see fig. XLIII): Medial bristles: The rostrum has rather sparse, in most cases bifurcated, bristles (of about the same type as is reproduced for *C. (Doloria) levis*, p. 228, fig. 2). Some of these bristles are arranged in a sparse row running obliquely upwards and forwards; sometimes this row is not distinct, in some cases, according to G. W. MÜLLER's statement, all these bristles are scattered. The arrangement and number of these bristles not only vary from one specimen to another but are also different on the two valves. Along the posterior edge of the rostrum there are also rather sparse bristles; at least some of them are bifurcated. The two bristles near the inner edge of the rostral incisur are about as large as the rostral bristles and seem to be furnished with fine, short hairs situated close together. Apart from these bristles there is often only a single short bristle inside the incisur near the joining line. Along the anterior part of the list behind the incisur to about a fourth or a third of the length of the shell there is a moderate number of bristles, mostly bifurcated; farther back they are practically entirely absent, though a few may sometimes be found. Inside the posterior margin of the shell the list is of the type described for *C. (V.) norvegica* (contrary to G. W. MÜLLER's statement). Between the list and the margin of the shell there are in most cases no bristles. The selvage is very wide along the posterior margin of the incisur, quite filling the latter (contrary to G. W. MÜLLER's drawing), continues along the whole of the ventral margin of the shell, extending here a little outside of it. On the anterior side of the rostrum it also extends beyond the edge of the shell, but, on the other hand, it is very narrow

along the posterior edge of the rostrum. It has uniform, close and fine cross-striation and is exceedingly finely serrated at the edge, almost smooth-edged.

First antenna: — The situation and the relative lengths of all the bristles seem to agree rather closely with *C. (V.) norvegica*, the posterior bristle of the fourth joint is, however, shorter relatively and the c-bristle of the seventh joint is somewhat, though rather slightly, longer than the g-bristle of the eighth joint. Presumably, however, the relative lengths of the bristles vary somewhat in this species as well. These two species also show very close agreement with regard to the number and type of the filaments of the bristles. On the proximal filaments of the sensory bristle of the fifth joint we find proximally from none to seven small secondary spines, some of them almost invisible. Of the bristles on the seventh and eighth joints the b-bristle has four filaments, the c-bristle ten, the f-bristle also ten and the g-bristle eleven filaments; these filaments are furnished with from none to five secondary spines. The simple sensory bristles d and e are about a third of the length of the c-bristle. Pilosity: The second joint has a more abundant pilosity than in *C. (V.) norvegica*.

Fig. XLIII. *C. (Vargula) antarctica* G. W. Müller. ♀. Anterior part of the right valve, seen from inside. 52 ×.

Second antenna: — This agrees in most respects with that of *C. (V.) norvegica*. It is to be noted, however, that the spines at the base of the bristle on the second exopodite joint seem to be almost or entirely lacking, and that the bristle on the second endopodite joint attains about the same length as or is somewhat shorter than the end joint of the endopodite. — According to G. W. Müller's statement (1908, p. 85) „das basale Glied“ (of the endopodite) is „kurz, mit einer Borstengruppe am Vorderrand nahe der Basis, zu der noch eine weiter distal stehende kommen kann“. Whether or not a variation is present in the last-mentioned bristle I have, of course, been unable to decide; it seems to me probable, however, that there is no variation, but that the statement is based on some specimens that were defective in this character. This assumption is supported by the state of affairs in *C. (V.) norvegica*, in which species this bristle is always found; cf. also several other species, for instance those of *Gigantocypris* and *Doloria*. The specimen investigated by me had this bristle developed as in *C. (V.) norvegica*.

Mandible: — This is extremely similar to that of *C. (V.) norvegica*. The anterior side of the second endopodite joint has comparatively few (eight were observed) more or less long bristles with short, fine hairs and has from seventeen to nineteen cleaning bristles.

Of the bristles on the end joint the two middle ones, which are developed like claws, seem to be somewhat more powerfully armed than those of the species in question.

M a x i l l a: — This shows close agreement with the maxilla in *C. (V.) norvegica.* The first endite of the p r o t o p o d i t e has eleven, the second five and the third five masticatory bristles. Distally-posteriorly the first e n d o p o d i t e joint has three bristles; the end joint has thirteen bristles; a few of the a-bristles have, however, some few rather strong secondary teeth at the middle.

F i f t h l i m b: — Only the left limb of one sexually mature female was investigated — This showed a very close agreement with the corresponding appendage in *C. (V.) norvegica*, the only differences that were observed being that the main tooth of the first e x o p o d i t e joint was composed of eight, and not seven, constituent teeth, that the fourth exopodite joint had only three bristles distally close to the inner edge and that the group of bristles situated proximally of these bristles was represented by a single bristle. — It is to be noted that the first endite of the p r o t o p o d i t e was defective, so that I cannot give any information about its structure in this species.

S i x t h l i m b: — This is very similar to the corresponding appendage in *C. (V.) norvegica*, but the specimen investigated had, however, only seven to ten bristles on the end joint.

S e v e n t h l i m b: — This is very similar to that of the preceding species. Cleaning bristles: There were seven ventral and five or six dorsal bristles situated very close together distally; proximally of these there were six or seven ventral and from six to nine dorsal bristles scattered irregularly. The single chitinous peg on the dorsal wall of the cavity dorsally of the end comb was finely serrated distally.

F u r c a: — This is also very like that of the preceding species. It is to be noted that in this species too, contrary to G. W. MÜLLER's statement, the third claw is somewhat, though only slightly, shortened and weakened.

U p p e r l i p, r o d - s h a p e d o r g a n, l a t e r a l e y e s: see G. W. MÜLLER's description.

Material of investigation.

Remarks: — As appears from the remarks on *C. (V.) norvegica*, p. 265, the above supplementary description is based on a sexually mature female, which was kindly sent to me by Prof. G. W. MÜLLER.

R[illegible]: C. (V.) norvegica.

A comparison between the descriptions given above of this species and *C. (V.) norvegica* will show that we are dealing with two rather closely related species. Possibly they ought to be denoted as representative forms in the Arctic and the Antarctic.

Parasites.

It may be pointed out in passing that, although both forms possess a parasite of the genus *Cyproniscus*, we are concerned, all the same, with two well-defined species of this genus, one infecting the arctic, the other the antarctic, species.

Distribution: — A n t a r c t i s: „Gausstation" of the G e r m a n S o u t h P o l a r E x p e d i t i o n, 1901—1903. Common, about 200 specimens were captured on several occasions. (G. W. MÜLLER, 1908.)

C. (Vargula) megalops G. O. Sars.

Cypridina megalops, G. O. Sars, 1872, p. 278.
" " G. S. Brady and A. M. Norman, 1896, p. 649; pl. LIV, figs. 5, 6.
" " G. W. Müller, 1912, p. 15.

Description: — Female: —

Length, 3 mm. Length : height, about 1,43 : 1; length : breadth, about 1,85 : 1. Seen from the side (fig. 1) it is broadly egg-shaped with the greatest height situated rather considerably behind the middle and the posterior part rather strikingly larger than the anterior one. The dorsal margin is rather boldly arched, its arcuation being somewhat more pronounced posteriorly than it is anteriorly, and, like the ventral margin, which is uniformly and somewhat more slightly arched, joining the anterior and posterior margins without decided corners. The rostrum is well rounded anteriorly or has a broadly rounded and rather weakly developed anterior corner; its ventral corner is rather well pointed. The rostral incisur is deep and narrow. The posterior part of the shell is broadly rounded and has a weakly developed and broadly rounded posterior corner at about half the height of the shell. Seen from below (fig. 2) the shell is oviform with its sides evenly arched and its greatest breadth situated somewhat behind the middle; the anterior end is somewhat more narrowly rounded than the posterior one. The surface of the shell is quite smooth except in the neighbourhood of the anterior margin of the shell, where it appears to have small, rounded cavities. The bristles of the surface seem practically to be entirely lacking. The pores of the surface are, on the contrary, very numerous and rather large and striking. Seen from inside (fig. 3): Medial bristles: On the rostrum there is a fairly close row of rather short and in most cases bifurcated bristles running obliquely upwards and forwards. The place on which the ventral ones of these bristles are fixed does not form a verruciform swelling. Apart from these bristles there are only a few found on the rostrum. Apart from the two bristles situated close to each other near the inner margin of the incisur there is generally only a single bristle inside the incisur; this bristle is short and is situated somewhat dorsally of the two just mentioned. Along the anterior part of the list there is a moderate number of bristles, mostly bifurcated, situated most closely just behind the rostral incisur and becoming more and more sparse posteriorly, but observable, however, along the whole ventral side of the shell. All the medial bristles are bare or almost bare. The list within the posterior margin of the shell is somewhat wider than it is anteriorly and has no other appendages except a comparatively few short, simple bristles, which are difficult to distinguish. On the part of the shell between the list and the margin there seems as a rule to be practically no bristles. The selvage is wide, extending rather considerably beyond the edge of the shell both along the anterior and posterior margins of the rostral incisur — the incisur is quite filled with it — as well as along the anterior edge of the rostrum. Along the whole ventral side of the shell the selvage also is comparatively wide — although considerably narrower than it is anteriorly — extending somewhat beyond the edge of the shell. It is finely and fairly uniformly cross-striated. The shell is rather strongly calciferous, but thin and fragile.

First antenna: — The bristles of the third, fourth and sixth joints and the a-bristle of the seventh joint have about the same position and the same relative lengths as in *C. (V.) norvegica*. The posterior bristle of the fourth joint is somewhat shorter relatively. All these bristles have short hairs or are almost naked. The sensory bristle of the fifth joint is of about the same length as the second to the fourth joints (counting on the posterior side) or somewhat longer. Of its thirteen sensory filaments — all entirely without secondary spines — the nine proximal ones are separated from the distal ones by a rather wide gap and, compared to the latter, they are relatively thick and long (attaining about a third to a half of the whole length of the bristle); the three following ones are only about a fifth of the length of the bristle, the distal one is still shorter. Of the bristles on the seventh and eighth joints the c-, f- and g-bristles are rather long, the c-bristle attaining about the same length as the seven distal joints, the f-bristle is somewhat longer, the g-bristle is about as long as the whole antenna. The b-bristle is about as long as the total length of the fourth and fifth joints and has five sensory filaments, each with one or two secondary spines. The c-bristle has ten sensory filaments each furnished with from none to two (most of the distal ones with none) secondary spines. The f-bristle similarly has ten sensory filaments, each with from none to five secondary spines. The g-bristle has eleven sensory filaments, each having similarly from none to five secondary spines. The secondary spines on all the distal bristles are rather strong. The simple sensory bristles d and e are about as long as the four distal joints. Pilosity: The second joint has anteriorly and posteriorly a few almost invisible transverse rows of short, fine hairs; apart from these this antenna is smooth.

Second antenna: — Protopodite: Length about 0,9 mm. The medial-distal bristle is of moderate length, not quite so long as the longest of the four proximal bristles of the first endopodite joint, bare or almost so (fig. 12). Exopodite: The first joint is about as long as the total length of all the following joints, the second joint about as long as the total length of the two following ones, the remaining ones are subequal. The bristle of the second joint is about as long as the total length of the six following joints, and is furnished ventrally with numerous moderately strong spines, arranged in two rows. The proportion between the length of the long natatory bristles and the total length of the exopodite is about three to two. These bristles are equipped with broad natatory hairs. The end joint has four bristles, of which the dorsal one is about as long as the total length of the five distal joints; like the others, it is furnished with long natatory hairs situated rather close together. The third to the ninth joints have powerful, rather long and conical basal spines, perhaps even a little longer relatively than those in *C. (V.) norvegica*; they decrease in strength and length the more proximally they are situated, the one on the third joint being of rather moderate proportions. At the base of the bristle on the second joint there are no spines at all. Endopodite: This is very short, two-jointed or with a very faint indication of being three-jointed. The first joint has a group of four bristles proximally, one of which is rather long, considerably longer than the whole endopodite, the three others not half as long as this bristle; they are bare or almost so. In addition there is presumably to be found a single bristle situated more distally on this joint, attaining

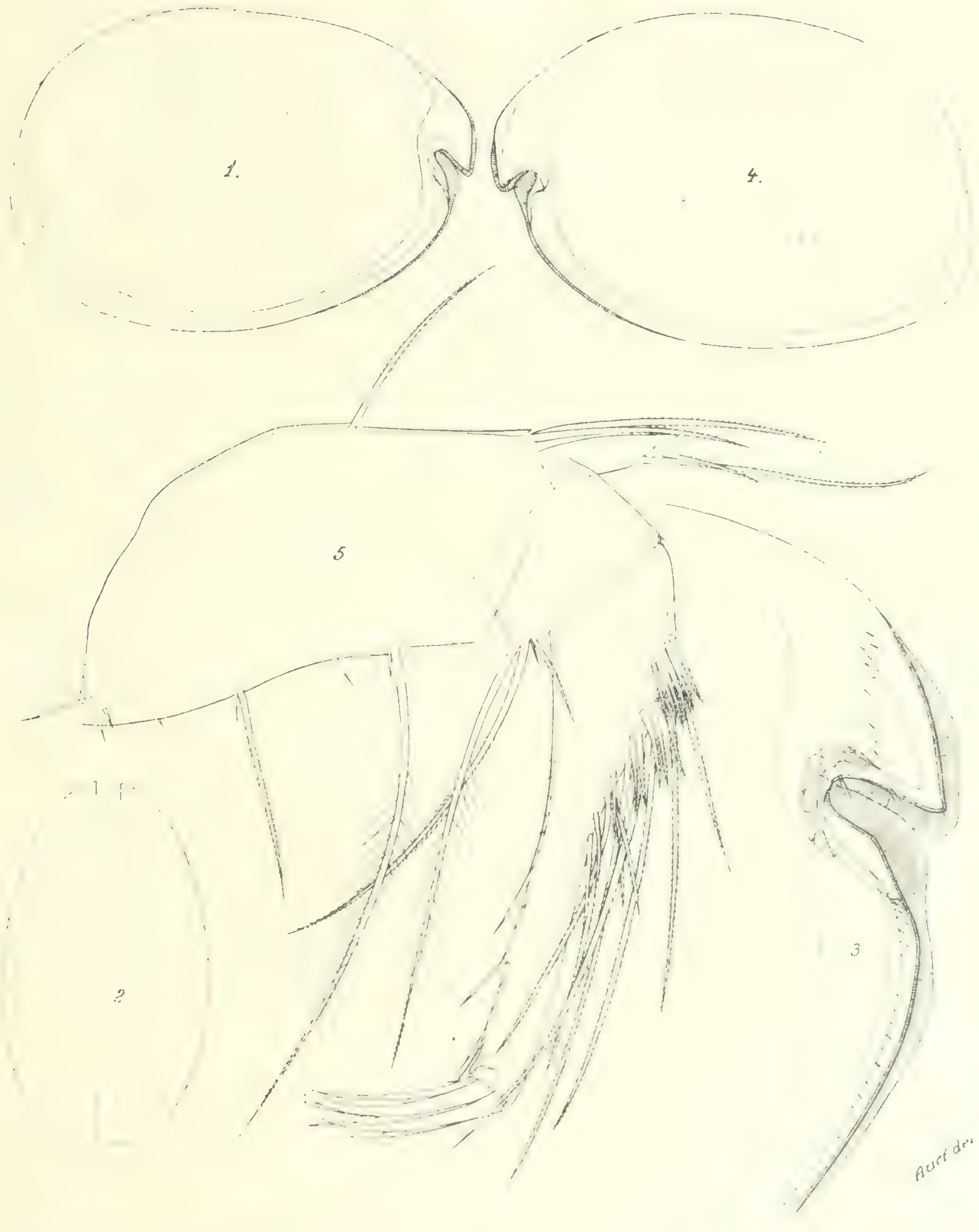

Fig. XLIV. — C. (Vargula) megalops G. O. Sars. — 1. Right valve, seen from the side, × 25.6. 2. Shell, seen from below, × 19. 3. Anterior part of the left valve, seen from inside, × 76. 4. Left valve, seen from the side, × 25. 5. Mandible, seen from inside, × 15.

about the same length as the longest proximal one; this bristle was, however, quite lacking in the specimen investigated; its probable existence is indicated partly by the presence of a similar bristle in the male of this species as well as in closely related forms, and also by the fact that on the endopodite on both sides of the female investigated there was, at the place where this bristle should have been situated, a circular opening in the chitin, such as arises when a bristle has been torn off.

M a n d i b l e: — P r o t o p o d i t e: The endite on the coxale is of about the same type as that of *C. (V.) norvegica*. Basale: This has nine bristles ventrally: three a-bristles, one b-bristles, two c-bristles and two d-bristles; between the two latter groups there is an additional bristle. Of these the a-bristles, the b-bristle, the shorter of the c- and d-bristles and the bristle between the last two groups are very short, the longer c-bristle is about as long as the height of the joint, the longest d-bristle is about as long as the second endopodite joint. Of the three dorsal bristles on this joint the proximal one is fixed at about the middle of the joint and is half as long as the joint, the two distal bristles, which are somewhat different from each other in length, are a little longer; all these three bristles have short, fine hairs. E x o p o d i t e: This is about as long as the dorsal side of the first endopodite joint or a little longer. Of its two bristles, both of which have short hairs, the distal one is about as long as the exopodite, the other one being about twice this length. E n d o p o d i t e: Of the four ventral bristles on the first joint the longest one has a rather large number of long secondary bristles and has short hairs distally, the other three bristles have short hairs. Second joint: On the anterior side this has eight or nine more or less long bristles, with short hairs, the longest of these extending with their points a little beyond the end joint, and ten or eleven cleaning bristles, all with rather fine double pectination. The arrangement of the latter bristles varies: sometimes they are clearly arranged in two rows running obliquely upwards and forwards, sometimes they are situated almost quite irregularly. On the posterior side this joint has four bristles, bare or almost so, situated in the same way as in the preceding species of this sub-genus. The two distal ones, which are situated close to each other, are somewhat shorter and weaker than the two others and of about equal strength; the medial one of them is only slightly longer than the lateral one. The bristles of the end joint are practically of quite the same type as that described and reproduced for *C. (V.) norvegica* except that the anterior and the posterior bristles are relatively somewhat, though only slightly, longer; all the bristles of this joint are smooth. Pilosity: The first endopodite joint has short hairs dorso-distally, the second endopodite joint has groups of short hairs situated transversely proximally on the anterior side and on the posterior side.

M a x i l l a: — P r o t o p o d i t e: The first endite has twelve powerful bristles, subequal and of moderate length, of the same types as the corresponding bristles in *C. (V.) norvegica.* On the three inner ones the secondary bristles continue right to the point of the bristle, on the others they stop a short distance from it; of the latter bristles five have a simple coarse point and four are tri-furcated distally. The second endite (fig. 6) has seven rather strong and moderately long bristles, all almost subequal except the inner one, which is only half the length of the others. Sometimes they are all furnished with a moderate number of long, stiff secondary bristles at the middle, sometimes there are no signs of any such secondary bristles on the third

bristle, counting from inside, which in that case is quite bare. The three outer ones are pectinated distally, the one situated nearest to them, which in most cases is somewhat more powerful than the rest, is either bare distally or has a few secondary teeth; the long one of the two inner bristles is tri-furcated distally, the small one has short hairs or is bare distally. The third endite has also seven distal bristles, rather strong and of moderate lengths, those situated distally (in the middle) being somewhat shorter than the others. Of these the inner one has short, fine hairs, all the rest are furnished at the middle with rather sparse, long, stiff secondary bristles; the two outer ones are pectinated distally, the rest seem to be smooth distally. The proximal bristle on the outside of the third endite has short, fine hairs and is not quite as long as the outside of this process. The dorso-distal bristle on the coxale is not quite as long as the outer-distal bristle on the third endite. On the boundary between the basale and the first endopodite joint there are three bristles. Of these the one that is fixed close to the exopodite is somewhat longer than the last-mentioned branch and is furnished at the middle with a few long secondary bristles, distally it is bare or has short fine hairs. The one at about the middle of the inside of the palp is about a third of the length of the former, the one on the anterior edge of the palp is slightly longer than the last-mentioned one; the two latter bristles are bare or almost so. E x o p o d i t e: Of the three bristles of this branch the distal one has short hairs, the two others are plumous. The two distal ones are subequal and of about the same length as this branch, the proximal one being somewhat shorter. E n d o p o d i t e (fig. 7, ♂ = ♀): The posterior-distal, chitinized, cutting edge of the first joint is rather strongly lobed, the lobes of varying types. Distally this joint has two bristles on its anterior edge and three on the posterior one of about the same proportions as the corresponding bristles in *C. (V.) norvegica*. The two anterior ones are practically quite bare; of the three posterior ones the long one is powerfully pectinated, the two others are bare or almost bare. The end joint has the same number of bristles as in *C. (V.) norvegica:* four a-bristles, three b-bristles, three c-bristles and three d-bristles; they are of about the same relative lengths as in the species mentioned, but somewhat weaker; their equipment, especially, is very weak; the a-bristles are bare, the two posterior b-bristles have only a few secondary teeth, the c-bristles similarly have only a few rather weak secondary teeth or are almost bare, and the same is true of the anterior d-bristle. The pilosity is similar to that of *C. (V.) norvegica.*

F i f t h l i m b: — P r o t o p o d i t e: The first endite (fig. 8, ♂ = ♀) shows a rather great resemblance to this process in *C. (Doloria) pectinata.* It is furnished with eight powerful masticatory bristles all of about the same type furnished with copious long, powerful secondary bristles, arranged more or less clearly in oblique wreaths. Of these bristles nos. 3, 5, 7 and 8, counting from the anterior side of the limb, are moderately long, decreasing somewhat in length the more posteriorly they are situated; bristles nos. 2, 4 and 6 form a similar series, but are considerably shorter than the former ones: no. 1 is very small. Second endite (fig. 9, ♂ = ♀): The five inner bristles are powerful masticatory bristles of moderate lengths, the three middle ones being somewhat shorter than the two outer ones. They are all, except the middle one, furnished with some wreaths of long, stiff secondary bristles at the middle. The middle one is sharply serrated distally, the rest are pectinated a short distance distally of the distal wreath

of secondary bristles, the pectination being rather weak on bristle no. 2, counting from the anterior side of the limb, most powerful on no. 5. The single bristle on the anterior side of this process is short and has short hairs. The seven bristles of the third endite (fig. 10, ♂ ♀) are powerful, especially the posterior one, and of moderate lengths; bristles nos. 4, 5 and 6, counting from the front, are somewhat shorter than the rest. Of these seven bristles either only the two anterior ones and the posterior one have at the middle wreaths of long, powerful secondary bristles while the others have no such bristles or else one may also find such wreaths on bristles nos. 4 and 6, counting from the anterior side of the limb. Bristles nos. 1, 2 and 4 with a moderately strong pectination distally; their points are, however, smooth; bristles nos. 3 and 5 are sharply serrated distally; nos. 6 and 7, especially the latter, are very strongly pectinated distally; on the former one the point is, however, smooth. The ventral chitinous spine of the protopodite is of moderate size and irregular. E p i p o d i a l a p p e n d a g e: This has from about 50 to 55 bristles, all with long hairs, but with smooth points. The e x o p o d i t e is five-jointed. First joint: The main tooth consists of seven constituent teeth, all well defined proximally; the secondary teeth of the latter vary to some extent, from a type about the same as in *C. (Doloria) levis* to that of *C. (V.) norvegica.* On the posterior side of this joint, close to the main tooth, there is one bristle, on the anterior side of the joint there are four, which show a close agreement with those of *C. (V.) norvegica*, but of these four the next innermost one is somewhat shorter and weaker than the one nearest to the main tooth and only weakly pectinated distally. The second exopodite joint has four a-bristles, seven or eight b-bristles, one c-bristle and one d-bristle. The equipment of the a- and b-bristles is possibly somewhat stronger than in *C. (V.) norvegica*; the c- and d-bristles are moderately long and have long, fine hairs at the middle, short, fine hairs distally. The following exopodite joints are quite of the same type as in the last-mentioned species, with about a similar equipment of bristles. The inner lobe of the third exopodite joint has two distal bristles and one proximo-posterior bristle, the outer lobe has two distal ones. The fourth joint has distally on the inner edge three or four bristles, proximally of which one or two bristles are to be found. The end joint has two distal bristles. The equipment of the bristles is also about the same as in the species mentioned. The pilosity is also similar in the two species.

S i x t h l i m b: — P r o t o p o d i t e: The first endite has two rather long and powerful distal bristles, furnished with some wreaths of long, stiff secondary bristles and two or three rather short, plumous medial bristles (on the right side of the only specimen that was investigated the medial bristles [two] were almost completely reduced [pathological?]; they were well developed on both limbs in the male). Second endite: This has two rather long and powerful distal bristles, furnished at the middle with long, stiff secondary bristles, distally pectinated, and, in addition, with three rather short, plumous, medial bristles. The third endite has four or five distal bristles, one of which is rather short, the rest rather long and powerful, subequal; they either all have long, stiff secondary bristles at the middle and short hairs distally or else one or two of them may have only short hairs. In addition there is on this endite a rather long medial bristle, plumous in the middle. The e p i p o d i a l a p p e n d a g e of the protopodite is represented by four short bristles, bare or almost so; sometimes the distal one of

Fig. XLV. — *C. (Vargula) megalops* G. O. Sars. — 6. Second endite of the protopodite of the maxilla, ♂; 312 ×. 7. Distal part of the endopodite of the right maxilla, seen from inside, ♂; 220 ×. 8. First endite of the protopodite of the fifth limb, ♂; 384 ×. 9. Second endite of the protopodite of the fifth limb, ♂; 440 ×. 10. Third endite of the protopodite of the fifth limb, ♂; 440 ×. 11. Left sixth limb, seen from inside, ♂; 136 ×.

these bristles is plumous. Exopodite: First joint: The endite has six or seven distal bristles and a rather long medial bristle, of the same types as the corresponding bristles of the preceding endite. Second joint: This has a rather large number (20–21) of rather long bristles of somewhat different lengths, all situated near the ventral edge. There is no pronounced gap between the posterior and the other bristles. Of these bristles the two or three posterior ones have long, soft hairs right to the point. A number of the rest have long hairs at the middle and short ones distally; the long hairs are soft on the posterior ones of these bristles and somewhat stiffer on the anterior ones and not clearly arranged in wreaths. Some bristles have only quite short hairs. Pilosity: On the inside of this limb there are short, fine hairs situated rather close together; along the ventral margin of the second exopodite joint there is laterally a series of short and rather stiff hairs.

Seventh limb (fig. 13): — This is relatively short, not attaining half the length of the shell (in the two specimens that were investigated, a male and a female, this limb was about 1.2 mm. long). Cleaning bristles: Distally, situated very close together, there are six or seven ventral and six dorsal bristles; of these — both in the case of the ventral as well as the dorsal ones — the one situated most distally is rather short, the next distal one is, on the other hand, relatively long; beginning from the latter these bristles decrease fairly uniformly in length the more proximally they are situated; one or two may, however, be exceptions to this rule; the proximal ones are rather short. Proximally of these bristles there are seven or eight ventral bristles and ten or eleven dorsal ones scattered irregularly, subequal, of moderate length, their lengths varying somewhat, however. The cleaning bristles are furnished with from one to seven bells cut off transversally distally; the tongue of the distal bell is cut off obliquely (of about the same type as in figs. 27 and 28 of *C. (Macrocypridina) castanea*); proximally of the bells the cleaning bristles are smooth. The end comb consists of from seven to nine long, distally rounded, distal teeth, subequal or decreasing somewhat in length the more proximally they are situated, and on each side of these there are four or five somewhat shorter proximal teeth. The cavity dorsally of the end comb is comparatively shallow; its dorsal wall has a low verruciform process; apart from this it is bare. This cavity has a special adductor (cf. the diagnosis of the sub-genus).

Furca (fig. 16): — This has eleven claws, all well defined from the lamella; beginning from claw no. 2, which is somewhat longer than claw no. 1, they decrease fairly uniformly in length the more proximally they are situated. Proximally of the claws the furca is smooth.

Upper lip: — All three glandular fields are moderately large; the unpaired dorsal one is somewhat larger than the two paired ventral ones. Some of the mouths of the glands in the former are directed obliquely forward, the others downward; the latter are situated in about the same plane as the mouths of the glands on the two paired, ventral glandular fields. (The upper lip shows a very great resemblance to that of *Cypridina dorsoserrata*, as this is illustrated in pl. IV, fig. 3, G. W. MÜLLER, 1908; it differs from this especially in having the three glandular fields separated from each other by deep grooves, as is shown in the diagnosis of the sub-genus.) The protuberance dorsally of the upper lip is rather high, with a simple point and somewhat rounded.

The r o d - s h a p e d o r g a n is moderately large and rather blunt distally.

The l a t e r a l e y e s are moderately large, with about 25 ommatids.

M a l e: —

S h e l l (fig. 4): — Length, 3,35 mm.; length : height, about 1,45 : 1; length : breadth, about 1,9 : 1. S e e n f r o m t h e s i d e it differs from the female shell in having the posterior

Fig. XLVI. — *C. (Vargula) megalops* G. O. Sars. — 12. Endopodite and the distal part of the protopodite of the second antenna, ♂; 184 ×. 13. Distal part of the seventh limb (bristles broken), with the end comb open, ♂; 576 ×. 14. Distal part of the seventh limb (bristles broken), with the end comb closed, ♂; 576 ×. 15. Left penis, seen from outside (drawn as if it were semi-transparent); 160 ×. 16. Furca, the secondary spines of the claws not drawn, ♂; 120 ×.

part relatively lower, and the posterior-ventral corner considerably better developed. In addition the anterior side of the rostrum, especially on the right valve, seems to form a somewhat more prominent — broad and well rounded — corner. The lines close to the rostral

incisur are somewhat different from those of the female (see the figures). No surface pores are visible. In other respects like that of the female.

F i r s t a n t e n n a: — This is slightly longer relatively than that of the female. Bristles of the seventh joint: The b-bristle is about as long as the anterior side of the second and the third joints; it has five filaments, of which the three proximal ones have suctorial organs. The proximal one of the three latter have distally of the sucker only an indication of a verruciform swelling. The two others, which are long and powerful, the distal one of them extending some distance beyond the point of the bristle, are furnished with from ten to thirteen small suctorial organs distally, proximally of which there is a small verruca. Distally of the three filaments just mentioned there are on this bristle two short, bare filaments. The c-bristle is somewhat longer than the preceding one, attaining about the same length as the anterior sides of the second to the fourth joints. It has ten filaments, of which the three proximal ones have suctorial organs; these three filaments are of quite the same types as the corresponding filaments on the b-bristle; on the two distal ones of them ten or eleven suctorial organs were observed. The seven distal filaments of this bristle are bare or almost so. Bristles of the end joint: The f- and g-bristles are subequal, not quite as long as the shell (length of the shell : length of these bristles about 11 : 9); the former has eleven, the latter twelve, filaments, each furnished with from none to four weak secondary spines. In other respects this limb agrees entirely with that of the female.

S e c o n d a n t e n n a: — This is slightly stronger than that of the female. E n d o p o d i t e (fig. 12): On the first joint this has, besides the group of four proximal bristles, a single distal bristle as well, of about the same length as the longest bristle in the proximal group. With regard to this character compare the description of the female given above. In other respects this antenna is quite like that of the female.

M a n d i b l e: — This is very like that of the female. The second e n d o p o d i t e joint has on the anterior side nine or ten more or less long bristles with short hairs and thirteen or fourteen cleaning bristles with varying arrangement. The two postero-distal bristles on this joint are almost equally strong, agreeing completely with those of the female; fig. 5.

The m a x i l l a and the f i f t h l i m b are like those of the female.

S i x t h l i m b: — This is very like that of the female, but the bristles are, however, furnished with softer hairs almost throughout. The numbers of bristles observed were as follows: P r o t o p o d i t e: First endite: two or three distal bristles and two medial bristles. The second endite: two distal bristles and three medial ones. The third endite: four distal bristles and one medial bristle. T h e e p i p o d i a l a p p e n d a g e is represented by three or four short bristles. E x o p o d i t e: The endite on the first joint has six distal bristles and one medial bristle; the second joint has 17 or 18 bristles; fig. 11.

S e v e n t h l i m b: — This is very like that of the female. The number of bristles observed was as follows: seven ventral and from five to seven dorsal ones concentrated distally; eight or nine ventral and nine or ten dorsal ones scattered proximally of these.

P e n i s (fig. 15): — Of the type characteristic for this sub-family; for details the reader is referred to the accompanying figure.

The furca, upper lip, rod-shaped organ and lateral eyes are like those of the female.

Remarks: — The above description is based on two specimens, a mature female and a mature male, which were kindly sent to me by Professor G. O. SARS for a supplementary investigation. To judge from a statement by G. O. SARS in his note under the original description, p. 279: „en fuldvoxen Hun med store gulrøde Aeg indenfor Skallen“ *, the female specimen investigated by me does not seem to be the same one as that on which G. O. SARS's original description was based, as the female I investigated had no eggs in the brood-chamber (the eggs in the ovaries were, however, rather large); moreover it was not dissected but quite intact. *Material of investigation.*

There can scarcely be any doubt, however, that the female investigated by me really belongs to G. O. SARS's *Cypridina megalops*. — G. O. SARS's original description of this form is very incomplete; G. W. MÜLLER (1912) indicates this species as unidentifiable. All the characters given by G. O. SARS agree, however, with only one slight exception. The second exopodite joint on the sixth limb should have only fourteen bristles, the five posterior ones of which should, in addition, be separated from the anterior ones by a gap. „Lamina terminalis subovata setis ciliatis circiter 14 posterioribus 5 ceteris intervallo brevi sejunctis marginata.“ *Identification. The female.*

The male of this species was previously entirely unknown. On account of the great resemblance it shows to the female, there can be little or no doubt that the male described above really belongs to this species. The only thing that might be said not to be in favour of this assumption is the fact that it is larger than the female. For if we are to judge from the literature the males of forms belonging to this sub-genus are always somewhat smaller than the females. *The male.*

This species occupies a somewhat isolated position from the two forms of this sub-genus that have been previously described on account of the following characters: *Position within the sub-genus.*

the considerable lengthening of the f- and g-bristles of the first antenna in the male,
the reduction of the endopodite of the second antenna,
the development of special muscles for closing the end comb of the seventh limb and
the strong development of the lateral eyes.

It did not seem proper to me to include as synonyms *Cypridina megalops* of A. M. NORMAN, 1891, p. 121 („doubtful origin“) and of C. H. OSTENFELD and C. WESENBERG-LUND, 1909, p. 113. The information about these is not accompanied by any descriptions or drawings to verify it. *Synonymy.*

Habitat: — The exact locale of the specimens of G. O. SARS investigated by me is unknown; it is presumably on the west coast of Norway.

Kristiansund, Norway: 1 mature female; W. LILLJEBORG coll. The specimen was in a very bad condition, but good enough for certainty of identification.

Distribution: — Norway: Hardanger Fjord.

* **Translation:** „a full-grown female with large yellowish-red eggs inside the shell.“

Sub-genus Macrocypridina* n. sub-gen.

Cypridina (part.). a u t o r u m.

Description: — S h e l l: — The form is somewhat, though only rather slightly, different in the males and the females. — It is oval with a well developed posterior corner. The rostral incisur is comparatively small, moderately deep and rather narrow. Near the inner edge of the incisur there are two medial bristles situated close to each other. Presumably with comparatively weak calcification. The species belonging to this sub-genus are comparatively large.

F i r s t a n t e n n a: — This is long, slender and eight-jointed. The sensory bristle of the fifth joint has thirteen sensory filaments. The b- and c-bristles of the seventh joint have a similar modification in the males as that described above p. 223 for the sub-genus *Doloria*. The proximal filament of these two bristles, which is situated a short distance from the base of the bristles, is, however, comparatively rather slightly metamorphosed; it is of moderate strength, is only slightly swelled proximally and is not strongly chitinized and spine-shaped distally, but more hyaline and ending in a short and very fine (sensory?) hair like most of the filaments on the bristles of the two distal joints of this antenna. The f- and g-bristles of the end joint are very much lengthened, being considerably longer than those of the females.

S e c o n d a n t e n n a: — The p r o t o p o d i t e has a medial-distal bristle. E x o p o d i t e: The bristle of the second joint is reduced. The natatory bristles of the third to the ninth joints have no trace of spines. The third to the ninth joints have basal spines. The e n d o p o d i t e is similar in the males and females, more or less strongly reduced, often with a reduced number of joints. The distal (sensory?) bristle of the end joint is very long.

M a n d i b l e: — P r o t o p o d i t e: The endite on the coxale is weakly bifurcated distally; its spines are arranged in distinct groups, those situated medially and distally being rather powerful. This joint has no bristles except for the small one on the endite. Basale: Of the ventral bristles one d-bristle is very long and has numerous long secondary bristles and short hairs distally, the rest are of moderate length or short and have short, fine hairs or are bare. This joint has three dorsal bristles. E n d o p o d i t e: The first joint has four bristles ventrally. The end joint has seven bristles, of which one of the anterior ones is long and powerful, claw-shaped, the rest being relatively short.

M a x i l l a: — P r o t o p o d i t e: Dorso-distally the coxale has a single bristle with long, fine hairs. Proximally on the outside of the third endite there is a single bristle. On the boundary between the basale and the first endopodite joint there are three bristles, one close to the exopodite, one at about the middle of the inside of the endopodite and one on the anterior edge of the endopodite. Dorso-distally on the coxale there is a rather large lamelliform e p i p o d i a l a p p e n d a g e. The e x o p o d i t e is relatively well developed, has long, fine hairs, situated close together, and is not displaced distally. The e n d o p o d i t e is relatively short and very broad.

* It is probably best not to use names ending with *Cypris* (e. g. *Gigantocypris*, *Pyrocypris*) for genera belonging to *Cypridiniformes*. This suffix may be reserved for real C y p r i d s.

S i x t h l i m b: — The second exopodite joint is rather short, somewhat rounded and furnished with rather numerous bristles. Its posterior distal bristles are not strikingly larger than the others.

S e v e n t h l i m b: — This is furnished with rather numerous cleaning bristles, a large number of which are placed very close together distally, the rest being scattered irregularly along the distal part of the limb. With regard to the situation of these latter bristles it is to be noted that more than one bristle is exceedingly seldom or perhaps never found on the same side of the same joint. The end comb consists of a moderate number of moderately strong teeth, firstly some rather long distal teeth more or less pointed distally, smooth except that they are furnished at the middle on both sides with a small secondary spine, and decreasing somewhat in length the more proximally they are situated, secondly somewhat shorter and broader proximal teeth, transversally cut off distally. Dorsally close to the end comb the wall of the limb is somewhat thickened and is furnished with a few wart-like chitinous processes. In addition it is slightly concave here; the dorsal and ventral walls of the cavity are not moveably joined to each other, but can, all the same, be pressed against each other like a jaw to some extent; when this happens, the distal teeth of the end comb are pressed in towards the dorsal wall of the cavity. The compression is carried out by a short, powerful, paired muscle, issuing proximally somewhat proximo-dorsally of the point of the limb and fixed distally to the bottom of the cavity.

F u r c a: — The lamellae are rather short. The number of claws is about nine, without any clear division into main claws and secondary claws.

U p p e r l i p: — This has only one large, rounded and quite undivided glandular field, directed forwards (corresponding to the unpaired dorsal glandular field in closely-related forms?). Ventrally of this there are on both sides some low pegs with glandular openings (corresponding to the two paired lower-posterior glandular fields in closely-related forms?). The ventral side is quite without glandular openings.

The r o d - s h a p e d o r g a n is comparatively small.

The l a t e r a l e y e s are well developed.

Remark: — It is certain that not more than one species of this sub-genus has been described in the literature, namely the one dealt with below, which is thus to be characterized as the type-species.

C. (Macrocypridina) castanea G. S. Brady.

Cypridina castanea, G. S. Brady, 1897, p. 88; pl. XVI, figs. 1—4.
„ „ G. W. Müller, 1906a, p. 130; pl. V, figs. 1, 2; pl. XXXIII, figs. 11—16; pl. XXXIV, fig. 10—13.
„ „ „ „ „ 1906b, p. 13.
?„ *obesa*, V. Vavra, 1906, p. 67; pl. VII, figs. 132b—142.
„ *castanea*, G. H. Fowler, 1909, pp. 279, 296; pl. 26, figs. 279—281.
„ „ G. W. Müller, 1912, p. 14.

Description: — Female: —

Shell: — Length, 6,3–6,8 mm. Length : height, about 1,55 : 1; length : breadth, about 2,1 : 1. Seen from the side (fig. 1) it is moderately elongated with its greatest height somewhat in front of the middle and the anterior part somewhat larger than the posterior one. The dorsal margin is rather strongly arched, either uniformly or often somewhat flattened at the middle, joining the anterior and the posterior margins without any indication of corners. The ventral margin is uniformly arched with a rather decided bulge anteriorly, somewhat more strongly arched at this part than the dorsal margin; joining without any sign of a corner the posterior margin, together with which it forms a slightly convex, straight, or sometimes even a very slightly concave line. The posterior part of the shell is drawn out into a sharply projecting, acute angled, but well rounded corner at or a little below half the height of the shell. The rostrum has a rather strongly projecting but broadly rounded anterior corner; its ventral corner is rather pointed. Seen from the side the rostral incisur is often of rather a varying type, the variations being obviously caused by the flexibility of the shell; yet it was not found to be so deep as it is shown in pl. V, fig. 1, G. W. MÜLLER, 1906 a. Seen from above (fig. 2), the shell is broadly lentiform with its greatest width a little in front of the middle and with uniformly curved side contours, which are, however, somewhat concave in front of the lateral eyes. The front and back ends are rather well pointed. The surface of the shell is quite smooth without any sculpture and quite without bristles. The pores of the surface are difficult to observe with certainty. Seen from within (fig. 3): Medial bristles: Near the ventral point of the rostrum there is a verruciform swelling, projecting rather strongly and directed inwards and downwards; it is furnished along the anterior side with a dense row of about 15 to 20 rather long and powerful and smooth bristles. Basally on this swelling there is a single tube-like bristle, thick but evidently very flexible; in some rare cases two of these were present. Dorsally of this swelling there is a row of bristles running upwards, of the same type as the first-mentioned bristles; the number of bristles in this row varies, from six to as many as sixteen have been observed. Apart from these just mentioned the rostrum is usually quite without medial bristles, but sometimes, however, one or a few short, scattered bristles may be found. The two bristles close to the inner margin of the incisur are of about the same type and size as the bristles in the row mentioned above. Above them, about half-way between the joining line and the margin of the shell or somewhat nearer the latter, there is a single bristle, quite short and rather weak. Besides these three bristles a few other short bristles are sometimes found inside the incisur. The list is usually quite without bristles along the whole ventral side of the shell even just behind the rostral incisur, where, in most forms of this family — in all that are described in this work — bristles are to be found. Posteriorly it has, however, a few bristles. The posterior part of the list, which is somewhat broader than the anterior one, is also characterized by pore-like formations, such as are reproduced on p. 228 of this work for *C. (Doloria) levis*, but I believe I have ascertained with certainty, with REICHERT's ocular 4, LEITZ' immers. $^1/_{12}$, that these do not end in a short bristle. (The list appears on the whole to be very like the one described for the species just mentioned, but has, however, still fewer bristles than this.) On the part between the list and the ventral and posterior margins of the

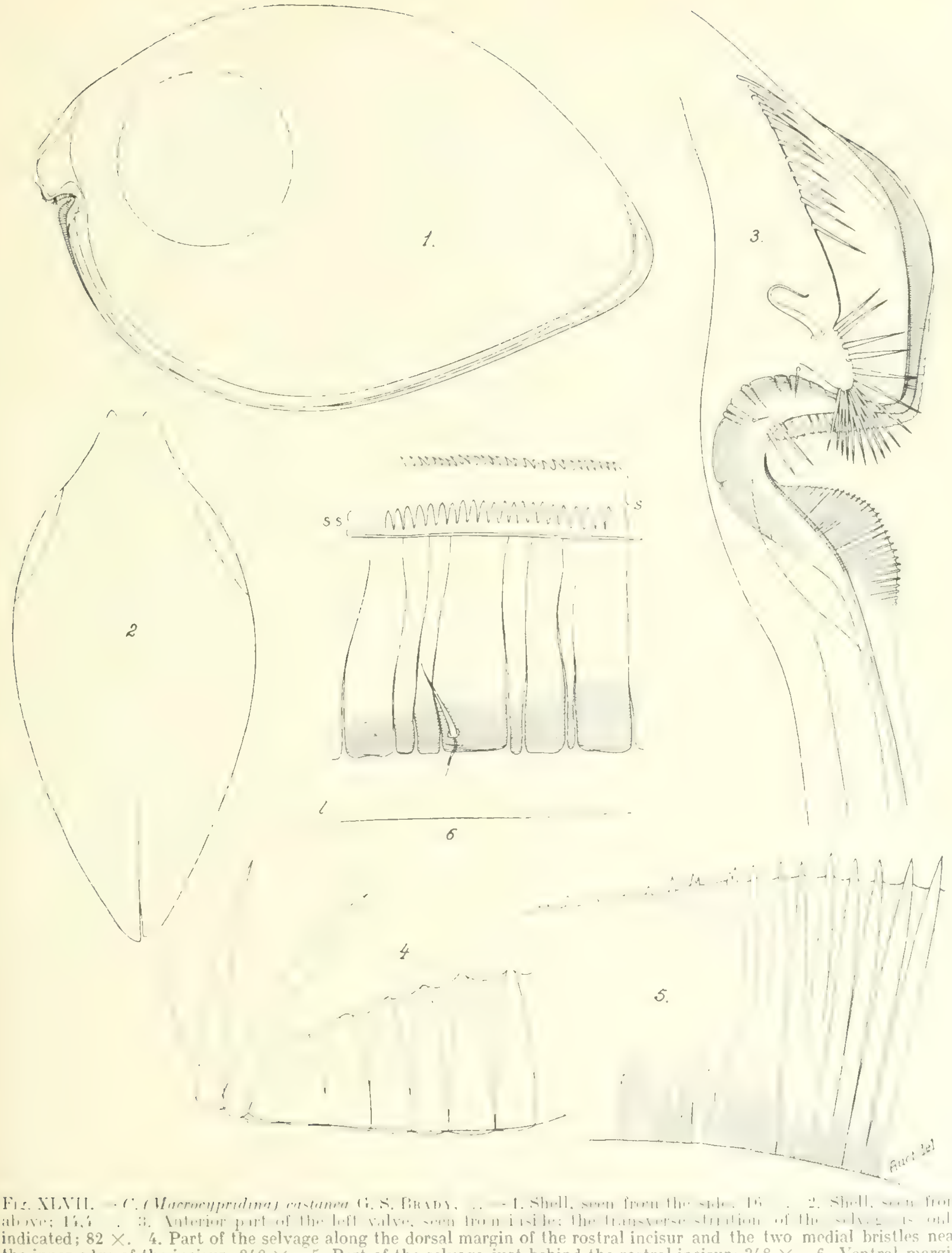

Fig. XLVII. — C. (*Macrocypridina*) *castanea* G. S. Brady, ♀. — 1. Shell, seen from the side; 16 ×. 2. Shell, seen from above; 14,4 ×. 3. Anterior part of the left valve, seen from inside; the transverse striation of the selvage is only indicated; 82 ×. 4. Part of the selvage along the dorsal margin of the rostral incisur and the two medial bristles near the inner edge of the incisur; 348 ×. 5. Part of the selvage just behind the rostral incisur; 348 ×. 6. Ventral margin of the shell; somewhat behind the middle of the shell; seen from inside; 504 ×.

shell there are a few short bristles to be observed, especially posteriorly near the margin of the shell; similar bristles may also sometimes be found inside the list. The selvage (figs. 4, 5, 6) is rather wide on the rostrum and has exceedingly fine and close cross-striation at this part — this striation could only be indicated quite roughly in the accompanying figure. This part of the selvage is sometimes divided into rectangular divisions varying in width; its edge is exceedingly finely serrated at this part. Along the anterior edge of the incisur the selvage has a structure like that shown in fig. 4, in other words it is divided into rather wide, conical parts, which are rather strongly chitinized; these cones at the edge produce an evident undulation; in addition an exceedingly fine striation can be traced here. Close to the two medial bristles at the inner margin of the incisur the selvage suddenly comes to an end. It is widest along the posterior edge of the incisur, and becomes narrower and narrower posteriorly, suddenly stopping on the ventral side of the shell about five sixths of the way along the shell. Along the posterior edge of the incisur the selvage is divided similarly into conical parts, rather strongly chitinized, but these cones are, however, considerably narrover than those which characterize the selvage on the anterior edge of the incisur; at the free edge of the selvage these conical parts continue as powerful, free points. Besides the cones the selvage is also characterized here by a close and exceedingly fine cross-striation; posteriorly the conical structures gradually disappear altogether and only the fine cross-striation is to be found, even the latter often only with difficulty; (this fine striation is only partly and very roughly indicated in the accompanying figure). Along the ventral side of the shell the edge of the selvage is closely and fairly finely serrated (see fig. 6). Just behind a point half-way along the shell a rather wide secondary selvage with very coarsely serrated edge (cf. fig. 6) issues basally on the inside of the selvage; it stops at a point somewhat in front of the posterior boundary of the selvage. The specimens examined by me (preserved in 85 % spirit) had leather-like shells, apparently quite without any calciferous incrustation. They are of a dark-brown colour and semi-transparent; outside the lateral eyes, however, the colour is almost completely absent on an almost circular part with a diameter of about a third of the length of the shell. (The boundary of this circle is indicated diagrammatically on the figure by means of a line; the transition from the pigmented to the unpigmented part is, however, gradual.)

F i r s t a n t e n n a (fig. 7): — The anterior bristle of the third joint, fixed somewhat proximally of the middle of the joint, the postero-distal bristle of this joint, the two bristles of the fourth joint, the bristle of the sixth joint and the a-bristle of the seventh joint are all comparatively weak, subequal, short, of about the length shown in the figure mentioned; their length varies, however, to some extent, though only very slightly; they all have short, fine hairs. The sensory bristle of the fifth joint is somewhat longer than the anterior side of the second and third joints. Of its thirteen sensory filaments the nine proximal ones are rather thick — of about the same thickness throughout — and long, being about a third of the whole length of the bristle. The three following filaments, situated at a considerable distance from the former ones, are much shorter and finer; their position relative to each other varies to some extent; sometimes they are scattered and sometimes situated very close together. The remaining one, situated at rather a long distance from the point, is exceedingly short. Of the bristles on the

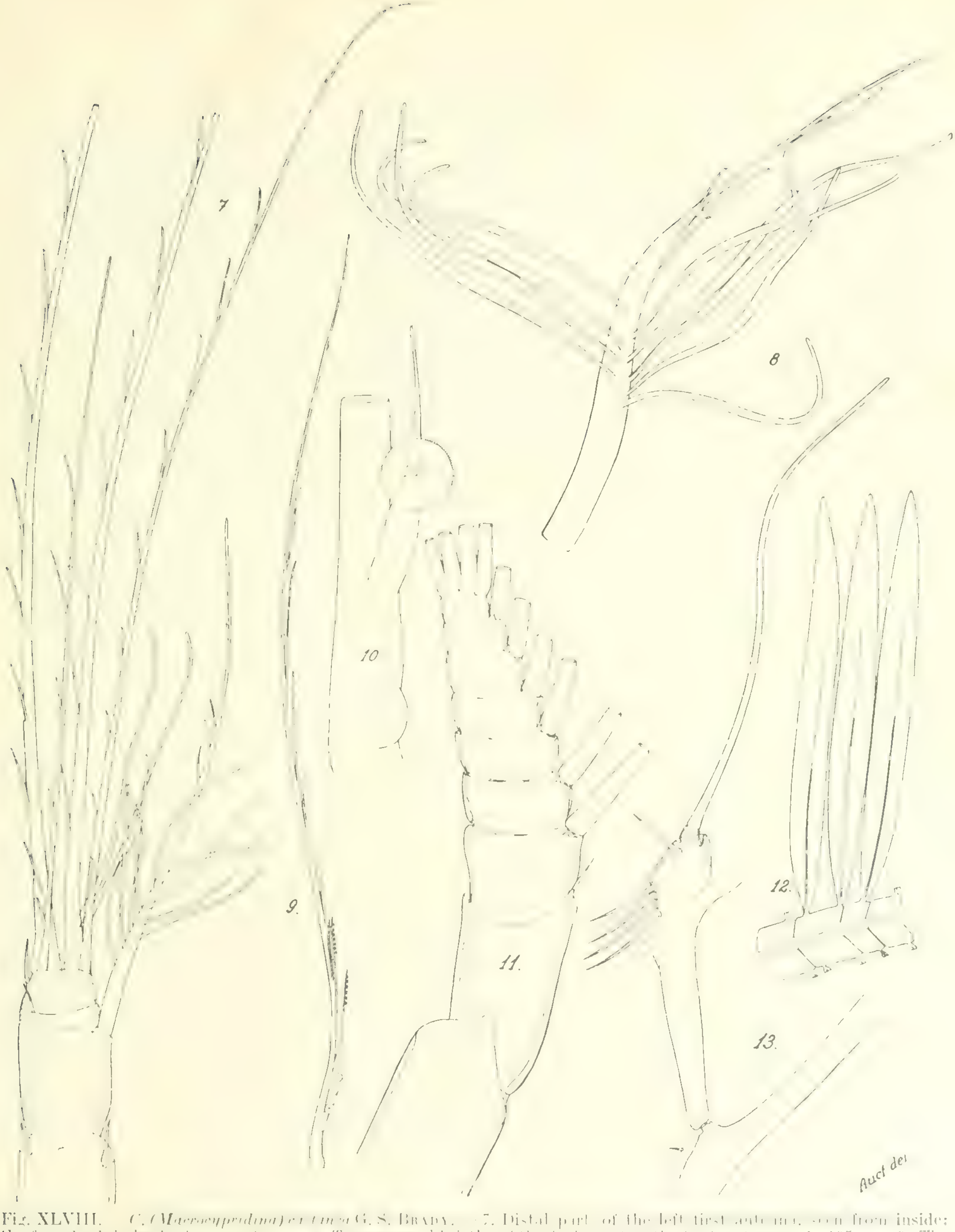

Fig. XLVIII. *C. (Macrocypridina) castanea* G. S. Brady. 7. Distal part of the left first antenna, seen from inside; the f- and g-bristles broken; ♂; 60 ×. 8. The sensory bristle of the fifth joint of the first antenna, ♂; 105 ×. 9. The c-bristle of the first antenna, ♂; 64 ×. 10. Proximal part of the last-mentioned bristle, ♂; 312 ×. 11. Distal part of the exopodite of the left second antenna, seen from outside; all the bristles of the seven distal joints broken, ♂; 84 ×. 12. Part of a natatory bristle of the exopodite of the second antenna with three natatory hairs, ♂; 312 ×. 13. Endopodite and the distal part of the protopodite of the second antenna, ♂; 156 ×.

seventh joint the b-bristle is moderately long, about equal to the length of the anterior sides of the second to the fourth joints (about 19—20 mm. in specimens with a length of shell of about 6.7 mm.); it has five scattered, moderately long, sensory filaments; its distal third is without any short sensory filament such as is found on most of the other end bristles. The c-bristle is somewhat longer than the former one, about 2.8—3.1 mm., i. e. not quite so long as the whole antenna; it has ten sensory filaments, nine rather long ones and a very short distal one. The f- and g-bristles of the end joint are subequal, very greatly lengthened, being about as long as the whole shell or even somewhat longer (on specimens with a shell about 6.7 mm. long these bristles had a length of from 6.8 to 7.1 mm.); with scattered and moderately long filaments varying somewhat in number, sometimes similar on both sides, sometimes different, different both on the right and the left antenna and from one specimen to another; the number observed was 18—21, the distal one of which was exceedingly short. The sensory filaments on all the bristles of the seventh and eighth joints are bare. The simple sensory bristles d and e are subequal and almost as long as the third to the eighth joints. Pilosity: The second and third joints are only weakly furnished with hairs, the rest of the joints seem to be quite smooth.

Second antenna: — Protopodite: Length about 2 mm. in specimens about 6.5 mm. long. The medial-distal bristle is almost completely reduced and is considerably shorter than the proximal bristles on the first joint of the endopodite. Exopodite (fig. 11): The first joint is somewhat longer than the total length of all the following joints; the second joint is about as long as the total length of the third and fourth joints, the third is about equal to the total length of the fourth and fifth or a little shorter, the remaining joints are subequal. The bristle of the second joint is very weak, quite bare and only about half the length of the third joint. The proportion between the length of the long natatory bristles and the total length of the exopodite is about three to two. The former have very wide natatory hairs (cf. fig. 12), which issue along the whole length of the bristle and even near the point where the bristle is attached. The end joint has four bristles, of which even the two dorsal ones are well developed; the shortest dorsal one, which, like the three others, has wide natatory hairs situated close together along its whole length, is about as long as the total length of the eight distal exopodite joints. The third to the ninth joints have short, conical and almost reduced basal spines; that of the end joint especially is extremely weak, sometimes even difficult to verify with certainty; the basal spines are sometimes provided with fine secondary teeth. The endopodite (fig. 13) is small, verruciform and more or less distinctly two-jointed. Proximally on the first joint there are four subequal, moderately long, bare or almost bare bristles. Distally on this joint there is a single bristle, in most cases somewhat shorter than the four proximal ones and of the same type as these. The bristle of the end joint is rather long, about a quarter of the length of the protopodite of this limb.

Mandible: — Protopodite: The endite on the coxale has over the greater part of the dorsal-lateral and dorsal-medial sides only a few short and rather weak spines; ventrally and distally, on the other hand, the spines are numerous and rather long and powerful. Distally it is weakly bifurcated; the two points are a good deal more powerful than the other spines and are furnished with a few secondary spines; between these two points there is a low

peg. Basale: This has seven ventral bristles, viz: two a-bristles, one b-bristle, two c-bristles and two d-bristles. Of these the a-bristles, the longer of the c-bristles and the d-bristles are of about the same proportions as are shown in pl. XVI, fig. 2, G. S. BRADY, 1897. The b-bristle and the shorter of the two c-bristles, which are not drawn in this figure of BRADY's, are short, the former being about the same length as the a-bristles and distinguished by being displaced to rather a great extent dorsally; the short c-bristle is almost entirely reduced. The three bristles on the dorsal side of this joint are about as long as these bristles on the above-mentioned figure of G. S. BRADY's, i. e. the proximal one, situated somewhat in front of the middle of the joint, generally does not reach with its point the distal boundary of the joint, the two distal bristles are subequal and slightly longer than the proximal one; all three have short hairs or are almost bare. Exopodite: This is somewhat longer than the dorsal side of the first endopodite joint. Its two bristles are relatively short, the proximal one of about the length of this branch, the distal one about half this length; both have short hairs. Endopodite (fig. 14): All the four bristles of the first joint have short hairs. The second joint has on its anterior side a sparse series of five moderately long bristles with short and sparse hairs; these bristles differ somewhat in length. In addition this joint has here a rather large number (about 28—35) of rather short cleaning bristles, arranged in several more or less irregular rows running obliquely upwards and forwards or else almost entirely without any regular arrangement. Most of the cleaning bristles have extremely fine and double pectination (of the type shown in fig. 8 of *M. (Cypridinodes) acuminata* in this treatise; drawn smooth in the adjoining figure); the rest are coarsely pectinated. Posteriorly this joint has four subequal bristles with short, coarse hairs, two next to each other distally, and two, one of them a little proximally of the other, a short distance proximally of the two former ones; the two distal ones are equal in strength. The end joint has seven bristles. Of these the medial-anterior one is rather powerful, claw-shaped, and rather long, generally about half the length of the second endopodite joint. The one situated most posteriorly is very weak and short, as is usually the case in this group of forms; the five remaining ones are subequal, rather weak and short; in most cases about half as long as the main claw. The main claw is bare, the remaining six bristles are more or less pectinated. Pilosity: The first endopodite joint has short hairs dorso-distally, the second endopodite joint has transverse rows of short, stiff hairs along the posterior side.

Maxilla: — Protopodite: The first endite (fig. 15) has in most cases twelve powerful bristles of moderate length. Of these the two inner ones are subequal, rather considerably longer than the others and furnished with two or three wreaths of rather short, stiff secondary bristles; distally of these they are rather strongly pectinated. The ten outer ones are often subequal; their lengths vary, however, to some extent; most of them have at the middle wreaths of long, stiff secondary bristles, more copious on the inner ones than on the outer, and distally of these more or less powerful secondary teeth. In a rather large number of specimens there was a slight variation from the type shown in the figure to be observed. Outside the outer bristle of those drawn in the figure an additional bristle may often be found; this thirteenth one is quite short and weakly pectinated. The second endite (fig. 16) has five rather powerful bristles of moderate length, the three outer ones usually somewhat longer than

the two inner ones, all pectinated distally; on the middle bristle, which is somewhat more powerful than the others, the pectination is rather coarse. In addition these bristles have at the middle one or two wreaths of long, stiff secondary bristles; the latter vary somewhat, sometimes occurring on all the five bristles, sometimes only on the two inner ones. The third endite (fig. 17) has seven distal bristles, similarly rather powerful and of moderate length; the ones situated most distally are somewhat shorter than the others. They are all weakly or moderately strongly pectinated, and the three distal ones are usually furnished at the middle with one or two wreaths of long, stiff secondary bristles, which do not occur on the others. The proximal bristle on the outside of this process is bare and about as long as the outside of the process. The bristle dorso-distally of the coxale is relatively long, rather considerably longer than the outer distal bristle of the third endite, being about half the length of the palp. Of the three bristles on the boundary between the basale and the first endopodite joint the one that is situated near the exopodite is rather long, being almost as long as the first endopodite joint, the one on the anterior edge of the palp is about as long as the outer-distal bristles on the third endite, the one at the middle of the inside of the palp being somewhat shorter; all three have short, fine hairs or are almost bare. Exopodite: The three bristles of the exopodite have fine, long hairs at the middle and short hairs distally; the two distal of these bristles are subequal, somewhat shorter than this branch, the proximal one is about half the length of these two. Endopodite: (fig. 18) The chitinized postero-distal edge of the first joint projects slightly and is only weakly lobed. Somewhat dorsally of this edge we find on the outside of this joint two or three short, smooth bristles or processes of somewhat different lengths, of a strange hyaline structure and directed upwards (shown in the figure by dotted lines). Distally on the anterior edge of this joint there are two moderately long, subequal and rather weak bristles with short hairs. Distally on the posterior edge there are three bristles, the posterior one of these being moderately long but rather powerful, the anterior one, the shortest and weakest, only about half the length of the former, all of them rather strongly pectinated distally. The end joint is rather strongly chitinized and has thirteen bristles: Four a-bristles of moderate length, rather strongly pectinated; three b-bristles of moderate length, of which the anterior one is of about the same type as the a-bristles, the two posterior ones, on the other hand, being extremely powerful and almost conical, with or without a few very powerful secondary teeth; three c-bristles of moderate length, the posterior one being the longest and the anterior one shortest; these too are of about the same type as the a-bristles; three d-bristles somewhat longer than the b-bristles but in other respects of the same types as these bristles; the posterior d-bristle is like the anterior b-bristle, the two anterior d-bristles are like the two posterior b-bristles. Pilosity: The first endopodite joint has transverse rows of short, fine hairs.

Fifth limb: — This is unusually elongated, the endites are comparatively widely separated from each other in about the same way as is shown in C. CLAUS's reproduction of *Cypridina messinensis*, 1865, pl. X, fig. 4. Protopodite: The first endite (fig. 19) has six bristles, arranged in two groups separated by a rather large space, an anterior group of four bristles and a posterior group of two. Of the former group one bristle is quite short and rather weak, with short hairs, and is situated somewhat inside the others. The three others are rather

Fig. XLIX. — *C. (Macrocypridina) castanea* G. S. Brady, [illegible] — 14. Endopodite of the right mandible, seen from inside; 104 ×. 15. First endite of the maxilla; 160 ×. 16. Second endite of the maxilla; 160 ×. 17. Third endite of the maxilla; 160 ×. 18. Endopodite and exopodite of the left maxilla, seen from inside; 104 ×.

long and powerful, the middle one being somewhat longer than the two others; they are furnished at the middle with from two to five wreaths of long, stiff secondary bristles and are rather strongly pectinated distally. Of the two bristles in the posterior group the anterior one is generally somewhat shorter than the posterior one in the anterior group, powerful, furnished at the middle with a few wreaths of long, stiff secondary bristles, and very strongly pectinated distally. The posterior bristle is considerably shorter, usually rather weakly pectinated distally and furnished at the middle with a wreath of long, stiff secondary bristles. Of the five inner bristles on the second endite (fig. 20), all rather powerful and moderately long, all except the middle one have one or more wreaths of long, stiff secondary bristles at the middle. Bristles nos. 1, 2 and 3, counting from the anterior side of the limb, are rather strongly pectinated distally, nos. 4 and 5 are somewhat angular and very powerfully pectinated distally. The single bristle on the anterior side of this endite is very short and weak and has short, fine hairs or is almost bare. Third endite (fig. 21): All the seven bristles of this process are rather long, except no. 6, counting from the anterior side of the limb, which is relatively short; no. 5 is also a good deal shorter than the others, but not so short, however, as no. 6. Of these bristles no. 1 is furnished proximally of the middle with one or a few wreaths of rather long, stiff secondary bristles and bristle no. 7 also has a few such secondary bristles at the middle (sometimes they are absent in the latter bristle; perhaps broken off?); the other bristles, on the other hand, have no such secondary bristles. Bristle no. 1 is rather weakly pectinated, bristles nos. 2, 3, 4 and 5 have rather strong pectination distally; bristles nos. 6 and 7 are somewhat angular distally and very strongly pectinated. The distal chitinous spine of the protopodite is rather long, narrow and bent. Epipodial plate: This has about 55 bristles, all with long hairs, their points being, however, bare. Exopodite: First joint: The main tooth (fig. 22) has seven constituent teeth all well defined proximally, whose secondary teeth are usually of the type reproduced in the adjoining figure. The bristle close to the main tooth on the posterior side of this joint is rather short, with sparse, short hairs. On the anterior side of the joint, near the main tooth, there are four rather powerful bristles, arranged in a close row, the one nearest to the main tooth being rather long, the rest decreasing rather rapidly in length the farther towards the outside of the joint they are situated. The two longer ones of them are rather strongly pectinated distally, but usually have no long, stiff secondary bristles, the two shorter ones are weakly pectinated distally and usually have a wreath of long, stiff secondary bristles at the middle. The second joint has four a-bristles. Of these the three larger ones are of about the type that has been reproduced in fig. 23 of *C. (Siphonostra) spinifera*, very powerful and furnished with very strong but rather few secondary teeth; the number and strength of the secondary teeth of these bristles seem, however, to be subject to rather great variation. The smallest a-bristle, the posterior one, is quite short and rather weak, usually bare but sometimes, however, furnished with some relatively coarse secondary teeth. There are also seven or eight b-bristles; only in one specimen was the latter number observed on the limb of one side; these bristles are moderately strong and of about the type reproduced in fig. 22 of *C. (Vargula) norvegica*. This joint has, in addition, one c- and one d-bristle, subequal and somewhat shorter than the longest b-bristles; the c-bristle has short hairs, the d-bristle has long, fine hairs at the middle and short hairs distally or is almost

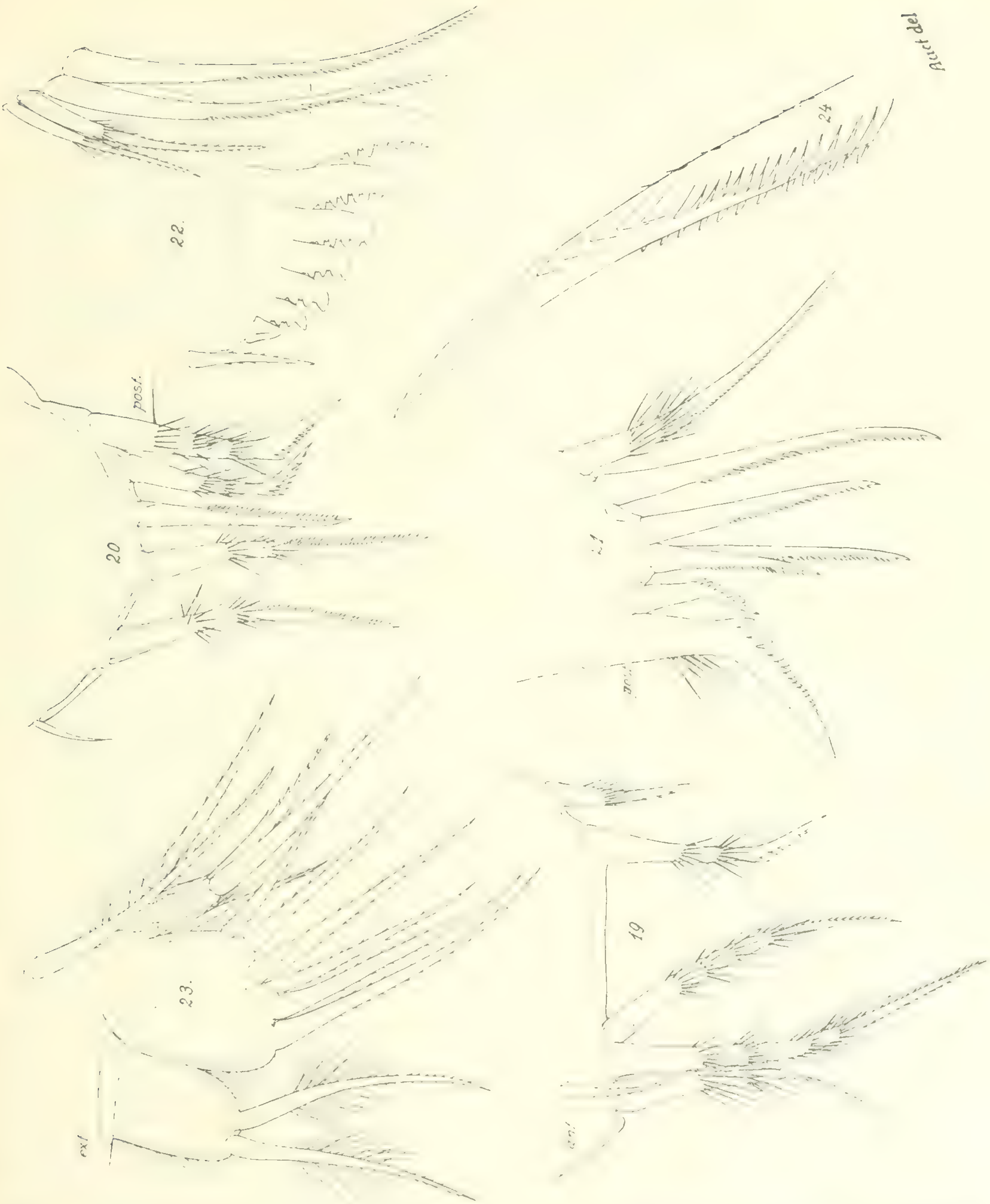

Fig. L. — C. (*Macrocypridina*) *castanea* G. S. Brady. ♂. — 19. First endite of the protopodite of the fifth limb, seen from inside; 192 ×. 20. Second endite of the protopodite of the fifth limb; 192 ×. 21. Third endite of the protopodite of the fifth limb; 192 ×. 22. Main tooth of the first exopodite joint of the fifth limb with the adjacent bristles; 192 ×. 23. Distal part of the right fifth limb, seen from in front; 192 ×. 24. Distal part of the first furcal claw, seen from inside; 316 ×.

bare at the latter part. The inner lobe of the third joint is rather small (fig. 23) and has two or three rather powerful distal bristles of moderate and somewhat different lengths, the lengths varying to some extent; these bristles have either short hairs or else rather coarse secondary spines. In addition this lobe has proximally on the posterior side a fairly long bristle, with short hairs distally and usually with long hairs at the middle. The outer lobe of this joint has two moderately long distal bristles, usually subequal, with long hairs at the middle and short hairs distally, but sometimes, however, the inner one, sometimes the outer one has only short hairs. The end joint, which is fairly large and without any signs of any further division into joints, has five or six, usually six, moderately long and rather powerful distal bristles; their relative lengths vary to some extent. Pilosity: The two last-mentioned joints are rather sparsely furnished with soft hairs.

S i x t h l i m b (fig. 25): — This is rather elongated and has a rather varying number of bristles; the types and relative lengths of the bristles also vary both from one specimen to another and on the right and the left side of the same specimen. P r o t o p o d i t e: The first endite has only one rather long and powerful distal bristle, furnished with about three oblique wreaths of secondary bristles and pectinated distally; this endite always seems to be without any medial bristles. The second endite usually has three distal bristles, of which the two dorsal ones are subequal, rather long and powerful and have at the middle a few wreaths of long, stiff secondary bristles and are pectinated distally; the ventral bristle is somewhat shorter, but powerful, at the middle it has a wreath of long, stiff secondary bristles, distally of which there are a few powerful secondary teeth. This process usually has, in addition, two short, plumous medial bristles. Variations in the number of the bristles were observed, the following numbers were found: three distal bristles + one medial bristle; three d. + three m., four d. + two m., four d. + three m. and even four d. + four m. The third endite usually has three distal bristles and one medial bristle. Of the former the middle one is of the same type as the ventral one on the preceding endite, the dorsal and the ventral ones vary in type, sometimes having short hairs, sometimes having one or a few wreaths of long, stiff secondary bristles at the middle and short hairs distally. The medial bristle is of about the same length as the distal bristles and has a wreath of long secondary bristles at the middle and short hairs distally. Variations were observed with regard to the number of bristles, the following numbers were found: three distal bristles + no medial bristle, three d. + two m. and four d. + one m. The e p i p o d i a l a p p e n d a g e of the protopodite is represented by from two to four short, bare or almost bare bristles. E x o p o d i t e: First joint: The endite usually has six distal bristles and one medial bristle. Of the former one of the middle ones is about the same as the ventral distal bristle on the second endite of the protopodite, the others are rather long and powerful, varying in type, sometimes having short hairs and sometimes with one or a few wreaths of long, stiff secondary bristles at the middle and short hairs distally. The medial bristle is similar to the corresponding bristle on the preceding endite, sometimes, however, having only short hairs. Other numbers of bristles that were observed were as follows: six distal + two medial bristles, five d. + one m. and three d. + one m. Second joint: This has from 25 to 32 bristles, some rather long and others rather short, all situated near the ventral edge; there is no pronounced gap

between the posterior and the other bristles. The two or three posterior ones either have long, soft hairs extending right to the point or else they have short hairs distally, the other bristles are all usually furnished with short, coarse secondary bristles, but sometimes, however, a few of them may be observed with a wreath of long, stiff secondary bristles at the middle. Pilosity: The inside of the limb is sparsely furnished with short, fine hairs; along the ventral margin of the second exopodite joint there is laterally a series of short, but rather stiff, hairs.

Seventh limb: — This is rather long, but not, however, quite so long as the shell (on specimens with shells 6,6—6,7 mm. long this appendage was about 5 mm.). Cleaning bristles: These are arranged in about the same way as in G. W. MÜLLER's fig. 13, pl. XXXIII, 1906a. There are from 14 to 16 ventral bristles and from 12 to 16 dorsal bristles situated very close together distally; proximally of these there are from four to seven ventral bristles and from five to seven dorsal bristles scattered irregularly. The distal one of the ventero-distal bristles is in most cases moderately long; the next distal one is very long (the proportion between these two is about the same as is shown in G. W. MÜLLER's figure referred to above) and considerably coarser than the others, most frequently the rest decrease fairly regularly in length the more proximally they are situated, the proximal ones being rather short; a few bristles may, however, form exceptions to this rule. The dorso-distal bristles also show a certain tendency to these proportions, the longest one being, however, rather considerably shorter than the longest ventral one. The scattered bristles are most frequently subequal and of moderate length. The longest ventero-distal bristle is usually quite without bells distally — only on one out of several specimens investigated was one bell observed on this bristle on the limb of one side — but is only furnished distally with a moderately strong double pectination. The other cleaning bristles are usually furnished with one or two — exceptionally three or four — bells cut off transversally or else more or less obliquely distally (figs. 27 and 28). The tongue of the distal bell is cut off very obliquely and is furnished with a moderately strong double pectination such as is described for the longest ventero-distal bristle; the teeth of the combs seem, however, in most cases to be somewhat more numerous and finer than on the last-mentioned bristle. Proximally of the bell most of the bristles are furnished with a dense covering of short fine hairs; the hairs, as far as I have been able to verify, are not arranged in wreaths. The end comb (fig. 26, [illegible]) consists of from four to six subequal distal teeth, rather pointed distally and, in addition, of from three to seven proximal teeth on each side of the former. Between the end comb and the dorso-distal cleaning bristle this limb is furnished with an unpaired and moderately strong chitinous process; this is furnished distally with a conical and rather powerful central tooth, bare or almost bare, and on each side of this a somewhat lamelliform process, armed distally with from about four to six serrate teeth. Between this chitinous process and the end comb there is, in addition, a chitinous process which is distally rounded, peg-shaped and bare. Both these processes vary somewhat in size and also in shape.

Furca (fig. 24): — This agrees very well with the description given by G. W. MÜLLER. The number of claws is in most cases nine; sometimes, however, there are only eight. With regard to their shape it is to be noted that they are often more regularly curved than in

G. W. MÜLLER's figure and that claw no. 1 is even somewhat shorter relatively to claw no. 2 than in this figure.

The lateral eyes, the rod-shaped organ and the upper lip agree very well with G. W. MÜLLER's description, the rod-shaped organ being, however, directed somewhat more upwards than in this author's figure.

Each female has from 50 to 75 eggs or embryos in the brood chamber.

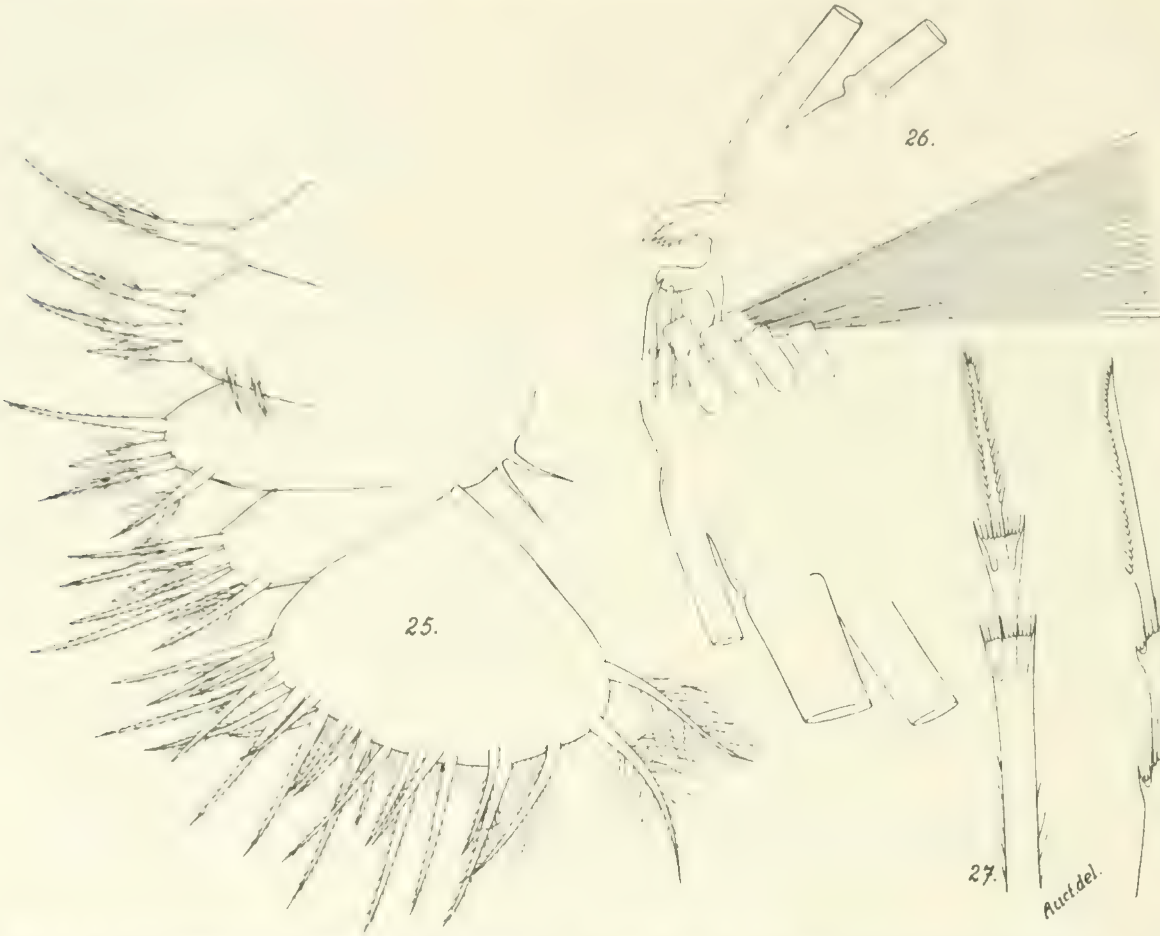

Fig. LI. *C. (Macrocypridina) castanea* G. S. BRADY. 25. Right sixth limb, seen from inside, ♂; 105 ×. 26. Distal part of the seventh limb; all the bristles broken, ♂; 680 ×. 27. Distal part of a cleaning bristle of the seventh limb, ♂; 1000 ×. 28. The same in another position; 1000 ×.

Male: —

Shell: Length, 6.4—6.6 mm. Seen from the side, it has almost entirely the same shape as that of the female, but the greatest bulge of the ventral margin is situated somewhat further back, so that the greatest height of the shell is about half-way along the shell; consequently it agrees fairly well with G. W. MÜLLER's figure 1, pl. V, 1906 a; sometimes, however, the difference from the shape of the female shell is almost imperceptible even in this point. Seen from above it agrees well with the description and figure of the female shell given above and therefore not with that of G. W. MÜLLER.

F i r s t a n t e n n a: — The sensory bristle of the fifth joint (fig. 8) is somewhat thicker proximally and grows narrow somewhat more abruptly distally than in the female; its nine proximal sensory filaments are longer relatively and are thicker at the middle, rather spool-shaped. Bristles of the seventh joint (figs. 9, 10): The b- and c-bristles are of about the same relative lengths and have the same number of filaments, five and ten respectively, as in the female. It is the three proximal filaments on these bristles that have suctorial organs. The proximal one of these three filaments has no verruciform process distally of the sucker. The two others are rather slightly stronger than the distal filaments and rather short relatively, of about the same length as most of the latter ones; they have from five to seven small suctorial organs distally, sometimes arranged rather irregularly; sometimes there is a small verruciform process distally or proximally of these. The other filaments on these two bristles are on the average somewhat longer than those of the female; the distal one on the c-bristle is exceedingly short. Bristles of the end joint: The f- and g-bristles are subequal and about twice as long as the shell (on one specimen, for instance, with a shell 6,5 mm. long these bristles were 13 mm. long, thus exactly double; in some cases they were somewhat shorter, in others even somewhat longer relatively). In spite of this great length they have about the same number of filaments (from 19 to 22 were observed) as in the female; these filaments are also on the average somewhat longer than in the female; the distal one is not short as is the case in the last-mentioned sex. In other respects this antenna agrees with that of the female.

S e c o n d a n t e n n a: — This is considerably stronger than that of the female. P r o t o p o d i t e: On some males with shells 6,5—6,6 mm. long this was 2,5—2,6 mm. in length. Exopodite: In the males mentioned above this was 2,2—2,4 mm. long (in some females with shells 6,6—6.7 mm. long this branch measured only 1,9—2,0 mm.); the natatory bristles somewhat, though only slightly, longer relatively than in the female. In other respects this limb agrees very closely in both sexes.

The m a n d i b l e, m a x i l l a and f i f t h l i m b are very like those of the female.

S i x t h l i m b: — This too shows very close agreement with that of the female, but the bristles seem, however, to be on the average somewhat fewer, especially on the second exopodite joint, on which only 20—25 ventral bristles were observed. This divergency seems, however, to be of less importance when one takes into consideration the comparatively great variability shown by this limb with regard to the number of its bristles.

The s e v e n t h l i m b is like that of the female; the end comb sometimes seems, however, to be somewhat weaker than in this sex.

The f u r c a, u p p e r l i p, r o d - s h a p e d o r g a n and l a t e r a l e y e s are similar to those of the female.

The p e n i s agrees with G. W. MÜLLER's description.

Remarks: — In spite of the incompleteness and uncertainty of G. S. BRADY's original description of *Cypridina castanea* there can scarcely be any doubt that the form described by me above is to be referred to this species. — Although the original description is so deficient there are, however, not a few differences that may be observed, but these are certainly to be

Differences from the original description.

explained as being due partly to obvious inaccuracies on the part of G. S. BRADY and partly to the superficiality of the description. With regard to the shell this author writes as follows: „the convexity of the sub-rostral cleft has a fringe of numerous slender spines, which are long in the middle of the series and gradually smaller towards the ends.“ This series of spines corresponds to the selvage. Further, if we are to judge from fig. 1, pl. XVI, the shell is characterized by a long row of short medial bristles along the anterior side of the rostrum in front of the row of bristles that is mentioned in the description I have given above and a shorter row of similar bristles within the two bristles close to the inner edge of the incisur. In both these cases it is clear that there has been confusion between bristles and pores on the margin of the shell. According to BRADY's figures there appear to be other divergencies in the proportion between the bristles on the end joint of the mandible and in the fact that the end joint of the maxilla has only two c- and two d-bristles.

Supposed relationship to Philomedes.

It may be pointed out as a curious fact that G. S. BRADY thought that he could observe a certain agreement with regard to certain characters between this species and — the genus *Philomedes*. „Provisionally, however, it may be referred to the genus *Cypridina*, though some of the characters show an approach to *Philomedes*.“ Such a statement cannot of course be explained unless we assume that this author did not have any detailed knowledge of the genus *Philomedes*.

Synonymy.

There are many reasons in favour of G. W. MÜLLER's assumption that *Cypridina obesa* VAVRA is a larva of the species dealt with above. In investigating a larva of the latter species with a shell of about the same length as that given for *C. obesa*, I found, however, that if this identification is correct, VAVRA must have committed not insignificant mistakes with regard to almost all the organs in his description and reproductions. When, however, one takes into consideration the superficial method that evidently has been employed by this author in working out the rest of the Ostracod material brought home by the „Plankton-Expedition“, such mistakes do not seem at all unlikely to have occurred.

The 1st antennae organs for taking up food?

The majority of the specimens of this species investigated by me, both males and females, had the long end-bristles of the first antenna stuck in the pharynx. When some of these specimens were dissected, it was observed that the ends of these bristles were rolled up in the stomach. This observation strongly supports the idea that these limbs are used to help in taking up food, a fact that has not been previously known. It is to be noted, however, that among all the very numerous specimens of other species belonging to this family I have never observed this phenomenon. Does this support the idea that it is only in the species treated above that this method of taking in food occurs?

Proportion between males and females.

In the material of this species investigated by me the males were somewhat fewer than the females but only very slightly so.

Periodicity of reproduction.

Among the mature females there were some with and some without eggs or embryos in the brood chamber in the samples from May as well as in those from July.

Colour of the larvae.

All the larvae, even those in the last larval stage, had no pigment, except on the stomach (cf. G. W. MÜLLER, 1906a, p. 130). Some mature females were considerably lighter in colour than the others; these had probably just undergone the last larval moult.

Shell of the larvae.

The larvae in the last larval stages have a shell of about the same shape as the mature males.

Habitat: — This species was captured by S S „Michael Sars" during the „North Atlantic Deep Sea Expedition" 1910 at the following stations: (all the hauls were made with open net).

Atlantic Ocean:

Stat.	23.	Lat.	35° 32′ N.,	long.	7° 7′	W.;	6/V.	200 m. wire out:	4 mat. spec.	
..	23.	..	35° 32′ ..	..	7° 7′	..	6/V.	400	4	
..	29.	..	35° 10′ ..	..	7° 55′	..	9/V.	2000	1	
..	34.	..	28° 52′ ..	..	14° 16′	..	14/V.	400	3	2 juv.
..	34.	..	28° 52′ ..	..	14° 16′	..	14/V.	600	1	
..	45.	..	28° 42′ ..	..	20° 0′	,,	28—29/V.	2000	1	1 juv.
..	49A.	..	29° 6′ ..	..	25° 2′	..	1/VI.	2000 ,, ...	1	
..	51.	..	31° 20′ ..	..	35° 7′	..	5—6/VI.	300	1	3 juv.
,,	51.	,,	31° 20′ ..	..	35° 7′	..	5—6/VI.	2000	1 ,, ..	
..	53.	..	34° 59′ ..	..	33° 1′	..	8—9/VI.	200		1 juv.
..	53.	..	34° 59′ ..	..	33° 1′	,,	8—9/VI.	300	2	
..	53.	..	34° 59′ ..	..	33° 1′	..	8—9/VI.	600	3 ,, ..	2 juv.
,,	53.	,,	34° 59′ ..	..	33° 1′	..	8—9/VI.	1600	1	
,,	58.	,,	37° 38′ ..	..	29° 20′	,,	12—13/VI.	300	5	1 juv.
..	62.	..	36° 52′ ..	..	39° 55′	..	20—21/VI.	300		2 juv.
..	62.	..	36° 52′ ..	..	39° 55′	,,	20—21/VI.	2500		1 ..
..	64.	..	34° 44′ ..	..	47° 52′	..	24/VI.	1000		2 juv.
..	64.	..	34° 44′ ..	..	47′ 52′	..	24/VI.	2000	12	1 juv.
..	66.	..	39° 30′ ..	..	49° 42′	..	26/VI.	1500	2	
,,	67.	,,	40° 17′ ..	..	50′ 39°	..	27/VI.	1200 ,, ...	7	
..	82.	..	48° 24′ ..	..	36° 53′	,,	13/VII.	1000	2	
..	90.	..	46° 58′ ..	..	19° 6′	..	21/VII.	1000	1	
..	92.	..	48° 29′ ..	..	13° 55′	..	24/VII.	300		1 juv.
..	92.	..	48° 29′ ..	..	13° 55′	..	24/VII.	1000	2	
,,	92.	,,	48° 29′ ..	..	13° 55′	..	24/VII.	2000 ,, ...	1	
..	98.	..	56° 33′ ..	..	9° 30′	..	5/VIII.	600		1 juv.

Distribution: — This species has been observed by previous expeditions at a number of stations in the Atlantic and Indian Oceans from lat. 43° N. to lat. 53° S. By means of the finds mentioned above it has been proved that the species is found in the Atlantic rather considerably more north — up to lat. 56° 33′ N. (Station 98). In the latter case it is probably a specimen carried north by the Gulf Stream.

With regard to its distribution vertically we may state with a certain amount of probability that its natural habitat is in moderate depths, from which it makes excursions into lesser depths.

Sub-Genus Siphonostra n. sub-gen.

Description. — Shell: — This is elongated and has a well-developed, beak-shaped posterior process. The rostral incisur is deep and narrow. Near the inner edge of the incisur there are two medial bristles situated close to each other. Posteriorly, within the posterior margin of the shell, the list is not developed. Seen from inside, the posterior beak-like process appears to have thin walls and to be constructed in such a way that when the two valves are close to each other a rather wide tube, a siphon, is formed, a character which gives the sub-genus its name. With rather strong calcification. The forms are of moderate size.

First antenna: — This is comparatively short and moderately slender; with eight joints; the proportions between the joints differ rather slightly from those given in the diagnosis of the sub-family; cf. the description of the species. The sensory bristle of the fifth joint has a comparatively small number of sensory filaments (always fewer than thirteen?).

Second antenna: — The protopodite has a medial-distal bristle. Exopodite: The bristle of the second joint is rather strongly developed. Some of the natatory bristles of the following joints have, in addition to natatory hairs, powerful spines as well. The third to the ninth joints have basal spines. The endopodite is reduced. (Similar in the males as in the females? Cf. below that *Cypridina hirsuta* G. W. MÜLLER may possibly belong to this sub-genus.) The bristle of the end joint is long.

Mandible: — Protopodite: The endite on the coxale is rather weakly bifurcated distally, furnished with a rather powerful equipment of spines especially medially-distally; the spines only with rather a slight tendency towards arrangement in groups. This joint has no bristle except the small one on the endite. Basale: Of the ventral bristles one d-bristle is very long, with numerous long secondary bristles at the middle arranged in irregular groups and with short hairs distally; the other ventral bristles on this joint are more or less short and have short hairs or are bare. This joint has three bristles dorsally. Endopodite: The first joint has four bristles ventrally. The end joint has seven bristles, of which the two middle ones are powerful and claw-shaped and of about the same length and strength.

Maxilla: — Protopodite: The coxale has distally a single bristle with short, fine hairs or almost bare. Proximally on the outside of the third endite there is a single bristle. On the boundary between the basale and the first endopodite joint there are three bristles, one close to the exopodite, one at about the middle of the inside of the palp and one on the anterior edge of the latter. Dorso-distally on the coxale there is a rather large and somewhat lamelliform epipodial appendage. The exopodite is comparatively well developed and has close, fine, long hairs; it is not displaced distally. The endopodite is very wide and of moderate length.

Sixth limb: — The second exopodite joint is very short, broader than it is long, furnished with rather few bristles; the posterior ones of these bristles are not strikingly larger than the others.

Seventh limb: — This is furnished with a moderate number of cleaning bristles a large part of which are situated close together distally, the rest being scattered on the dorsal and ventral edges somewhat proximally of these; with regard to the situation of the scattered proximal bristles it is to be noted that we never find more than one bristle on the same side of the same joint. The end comb consists of a moderate number of rather powerful teeth, among which can be distinguished distally rounded or more or less pointed distal teeth, bare or with only a weak spine on each side at the middle, and also bare proximal teeth cut off transversally distally. Dorsally, close to the end comb, the wall of the limb is very much thickened, strongly chitinized and also deeply concave. The ventral portion of the wall in this concavity, the part that is enclosed by the end comb, is continued proximally as a powerful chitinous process, to which the chitinous part that forms the dorsal wall of the concavity is moveably joined. The dorsal and ventral walls of this concavity can be pressed together like a jaw; when this occurs the distal tooth of the end comb is also brought against the dorsal wall of the concavity. This compression takes place by means of a short, powerful, paired muscle, issuing proximally somewhat proximo-dorsally of the point of the limb and fixed distally to the proximal process of the chitinous plate that forms the ventral wall of the concavity.

Furca: — The lamellae are moderately elongated. The number of claws is about eight; the division into main and secondary claws is rather faint.

The upper lip has three glandular fields, one dorsal, unpaired, directed forwards and downwards and two ventral ones, paired; they are all separated from each other by deep furrows. There is no large and conspicuous process. Dorsally of the lip there is an unpaired protuberance.

The lateral eyes are well developed.

Remarks: — Of this sub-genus only the species dealt with below — the type species [illegible] — is known with any certainty. It seems, however, not impossible that at least one species that has been previously described is also to be included in this sub-genus, namely *Cypridina nobilis* P. T. Cleve (1905 a, p. 134, pl. VII, figs. 3—5, 8; pl. VIII, figs. 10, 11; pl. IX, figs. 15—18, 22), for this species, as far as one can judge, has posteriorly on the shell a siphon similar to that which is characteristic for the form dealt with here. The incomplete description does not, however, permit of any definite decision in this question.

Whether *Cypridina hirsuta* G. W. Müller (1906 a, p. 131, pl. XXXIII, figs. 1—10) belongs to this sub-genus is a still more difficult question to decide; it is, however, not impossible that this is the case.

In my opinion the most interesting point about the species described above is that, if I am not mistaken, it may perhaps make it possible for us to understand the systematic position of the genus *Heterodesmus*.

This genus was established by G. S. Brady, 1865, p. 387, and was based on a single species, *H. Adamsi*. The description of this species is exceedingly incomplete and also presumably partly incorrect; only some characters of the shell are mentioned, „animal unknown". In the above-mentioned work the genus *Heterodesmus* was placed in the family *Cypridinidae*. In a later work, 1868 b, p. 358 the same author makes this genus, together with the genus

Entomoconchus M'Coy, form a special family, *Entomoconchidae*, by the side of the families "*Cypridinidae* and *Conchoeciadae*" within the section *Myodocopa*. G. S. Brady and A. M. Norman, in their work of 1896, p. 628, write of this genus that it "probably will be found to belong to the group *Myodocopa*". When in 1902 a, p. 188 G. S. Brady established the genus *Codonocera* he wrote the genus *Heterodesmus* as a synonym: "? *Heterodesmus* Brady." Since then — if we are to judge from the literature — this form has never been found again, nor have any new species been described that can be referred with certainty to this genus.

On account of the incompleteness of the description G. W. Müller, when revising the Ostracod group, did not think it possible to place this genus systematically. In his synoptic work of 1912, p. 398 he puts it under the heading of "Ostracodum genera et species incertae sedis"; in doing so he wished to point out that it is even impossible to decide which main group within the *Ostracoda* this genus belongs to. Other authors who deal with this group do not touch upon this genus.

Even from the shape of the shell — the strongly ventricose ventral margin and the presence of a rostral incisur (the latter is, however, only very indistinctly indicated in the figure and is not mentioned in the text) — it seems very probable that the genus *Heterodesmus* is to be placed within the group *Myodocopa*, as G. S. Brady has already done. The fact that the species in question was caught swimming freely in the sea, "taken in the towing-net", also supports this supposition. It also seems to me very probable that this genus is closely connected with the sub-genus *Siphonostra* established by me above. This is supported, above all, by the fact that, to judge from figs. 6a, g and h, *H. Adamsi* has a shell that is developed postero-dorsally into a siphon (presumably) of quite the same type as that of the last-mentioned sub-genus. The hinge of the shell points to the same conclusion. The question as to whether the two forms are distinguished from each other generically or not can, of course, not yet be decided, though it does not seem impossible that at some future time it will appear that they ought to be included in the same sub-genus.

With regard to G. S. Brady's assumption that *Heterodesmus* is a synonym of the genus *Codonocera* I may merely point out here that — to judge from the literature — the shell of the latter genus is not developed as a siphon posteriorly.

Siphonostra spinifera n. sp.

Description: — Female: —

Shell: — Length, 2.32 mm. Length: height, about 1,8 : 1; length : breadth, about 1.75 : 1. Seen from the side (fig. 3) it is very elongated with the greatest height at about a third of the distance along the shell; the anterior part is slightly larger than the posterior one. The dorsal and ventral margins are of about the same shape, uniformly arched, the arcuation is moderately strong; they join the anterior and posterior margins without corners. The posterior part of the shell is, at about half the height of the shell, drawn out into a rather wide process cut abruptly off distally and directed obliquely upwards; the ventral margin of

this process is uniformly and weakly convex, forming a uniform continuation of the ventral margin of the shell; its dorsal margin is, on the other hand, rather strongly concave. The rostrum has a rather prominent, broadly rounded corner anteriorly; this corner is, however, less striking because the ventral portion of the anterior margin of the rostrum, seen from the side, is covered by a low, broadly rounded verruciform process, issuing ventrally on the rostra of both valves and directed forwards and downwards; the ventral corner of the rostrum is almost rectangular. Seen from below (fig. 4) the shell has its greatest breadth at about the middle; the posterior siphon-shaped process is well defined. Seen from the front the shell appears almost circular. The surface of the shell is without ridges and other sculptural elevations except for the above-mentioned low, broadly rounded, verruciform process situated ventrally on the rostrum and a low rounded elevation situated just ventrally of the rostral incisur, a short distance inside the margin of the shell. On the type specimen this last-mentioned process was somewhat larger on the right valve than on the left one and covered the margin of the shell to some extent when the shell was seen from the side; to judge from the larva (male) that was also investigated, this character seems, however, to vary somewhat. The whole surface of the shell is covered by numerous rounded cavities, which are situated rather close together, are moderately deep and vary to some extent in size, those situated near the margin of the shell being rather small and most of those situated farther in somewhat larger. In addition it is to be noted that on the rostrum, on the part just behind the rostral incisur and on the siphon the surface of the shell, near the margin, has diminutive warts. The pores of the surface are small and moderate in number, either with or without a short, fine bristle. Seen from inside (fig. 5): Medial bristles: On the rostrum there is a sparse row of rather long bristles which runs obliquely forwards and upwards; most of these bristles are bifurcated and are furnished with long, fine hairs arranged close together in the shape of a feather; the others are generally simple and smooth. In addition on the rostrum behind and above this row there is a moderate number of scattered, smooth, short, simple bristles. On the anterior side of the incisur there are a few rather long or rather short bristles, most of them apparently simple and smooth. The two bristles situated close to each other near the inner edge of the incisur are bifurcated, smooth or almost smooth, the anterior one being rather long; above these there is a single, bifurcated, rather short, bare bristle. On the list behind the rostral incisur there is a rather dense row of bristles, all rather long, bifurcated and furnished with long hairs situated close together and arranged in the shape of feathers (one of the anterior of these bristles is reproduced in fig. 6). This row of bristles stops suddenly at about a third of the distance along the shell; a few single, simple, smooth, rather short bristles may, however, be observed on the list along the posterior part of the ventral side of the shell. A few, simple, short, smooth, scattered bristles are to be found between the list and the inner line just behind the rostral incisur; on the part between the list and the ventral margin of the shell no bristles seem to occur. The inner walls of the posterior process of the shell, the siphon (fig. LII), are almost perfectly smooth, with only weakly developed, reticulate sculpture (giving an apparent effect of scaliness) and have a few scattered short simple bristles. Note also in fig. 4 the complicated structure of the joining line and the marginal pores. The exit outwards of the siphon is a rather wide,

almost circular opening. The siphon is cut off anteriorly by a narrow, high, irregular wall, differing somewhat on the right and the left valve; communication between the siphon and the larger anterior cavity of the shell takes place principally through a rather narrow, irregular opening situated at about the centre of this separating wall (this opening marked by* in the adjoining figure) and on the left valve by means of a smaller opening situated dorsally (shown by** in the figure mentioned). For further details about the structure of this separating wall it seems to me most convenient merely to refer to the accompanying fig. LII. Dorsally a short distance in front of this wall, there is on both the right and on the left valve a rather long and somewhat irregular peg, directed downwards and somewhat backwards. On the right valve the hinge is furnished with a long, wing-shaped and rather strongly projecting tooth; this tooth

Fig. LII. — *C. (Siphonostra) spinifera* n. sp. — The posterior part of the shell seen from inside. 1. Right valve, ♂. 2. Left valve, juv. ♂.

suddenly ceases anteriorly, a striking, almost rectangular, corner is formed, and decreases gently and uniformly in height posteriorly. On the left valve there is a cavity corresponding to this tooth. (In the accompanying figure 5 this tooth is only indicated schematically by a curved line.) I did not succeed in finding any hinge tooth posteriorly either on the right or the left valve. The selvage is very wide along the anterior and posterior margins of the rostrum and along the posterior margin of the rostral incisur — the incisur is quite filled by it — and along the anterior part of the ventral margin of the shell; it continues along the whole ventral margin of the shell, extending somewhat outside the edge. It is uniformly and finely cross-striated and is extremely finely, almost invisibly, serrated at the edge or else smooth-edged. The shell is presumably rather strongly calciferous — although the type specimen had a soft shell, not calciferous; a larva, preserved in the same liquid as the type specimen, had in its shell numerous rounded calcareous concretions.

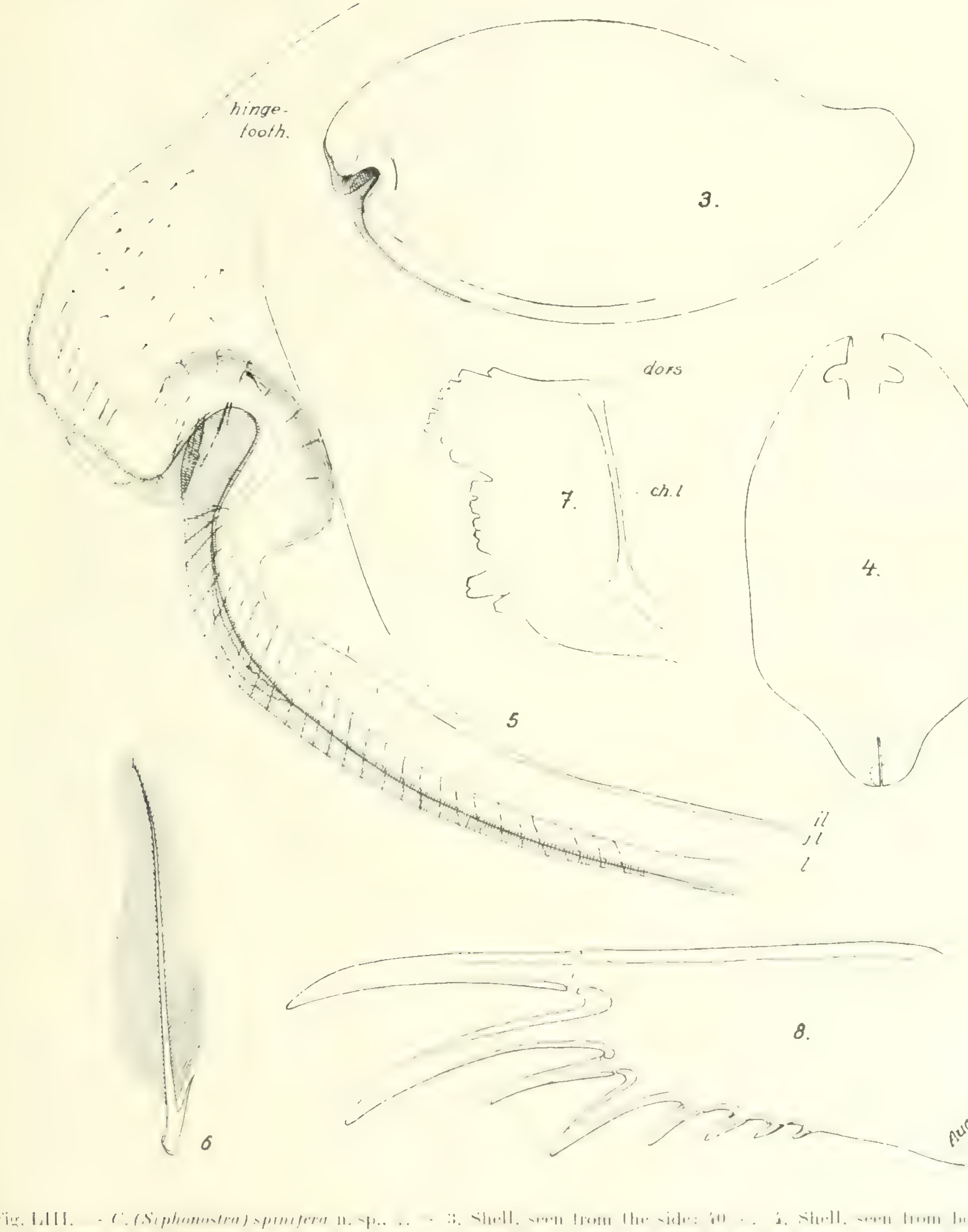

Fig. LIII. — *C. (Siphonostra) spinifera* n. sp., ♀. — 3. Shell, seen from the side; 40 ×. 4. Shell, seen from below, the opening of the siphon represented by a dotted circle; 31 ×. 5. Anterior part of the right valve, seen from the inner side, 138 ×. 6. One of the anterior bristles on the list just behind the rostral incisur of the shell, 617 ×. 7. Upper lip, seen from the side, 166 ×. 8. Furca, the secondary teeth of the claws are not drawn, 166 ×.

First antenna: — The fifth and sixth joints, although still free, seem to show a certain tendency to become joined to each other. The approximate proportions between the joints are as follows:

I [illegible] : II [illegible] : III [illegible] : IV [illegible] : V [illegible] : VI [illegible] : VII [illegible] : VIII 0,3.

The most striking fact is perhaps the great reduction of the third joint; this joint has, however, no marked tendency to become joined to the neighbouring joints. The posterior bristle of the third joint and the postero-distal bristle of the fourth joint are about subequal and almost completely reduced; their length corresponds to about the breadth of the sensory bristle of the fifth joint proximally. The anterior bristle of the third joint, the antero-distal bristle of the fourth joint, the medial distal bristle of the sixth joint and the a-bristle of the seventh joint are all subequal, of about the total length of the fifth and sixth joints and have short, fine hairs. The sensory bristle of the fifth joint is somewhat longer than the anterior side of the seven distal joints (the proportion is about 57 : 50) and has eleven sensory filaments. The seven proximal ones of these are fixed between about a third and a quarter of the distance along the bristle, are rather thick and long, being about a third of the whole length of the bristle, and are bare. The three following ones are considerably shorter, about a fifth to a sixth of the total length of the bristle, and narrow; they are furnished with a few, about one to three, weak secondary spines, and are separated from the others by a decided gap. The most distal of these filaments is quite short and bare, and is fixed near the point of the bristle. Of the bristles on the two distal joints the b-bristle is not quite as long as the five distal joints, and has four short filaments which are almost quite bare; the f-bristle is about as long as the anterior side of the seven distal joints and is characterized by eight or nine filaments, the c- and g-bristles are subequal and about a third longer than the last-mentioned one and have ten filaments. Some of the proximal filaments on the three last-mentioned bristles, the c-, f- and g-bristles, have a few (about one to four) short, weak secondary spines. The two simple sensory bristles d and e are subequal and almost as long as the anterior side of the second joint. Pilosity: The second joint is rather well furnished with hairs, especially postero-distally; otherwise this limb is smooth.

Second antenna: — Protopodite: Length, about 0,6 mm. The medial-distal bristle is relatively long, of about the same length as the longest of the bristles of the first endopodite joint; it has short, fine hairs (fig. 10). The exopodite (fig. 9) has about the following proportions between the joints:

I : II : III : IV : V : VI : VII : VIII : IX = 30 : 6 : 3 : 3 : 3 : 3 : 3 : 2 : 2.

In other words the first joint is somewhat longer than the total length of all the following joints, the second joint is about as long as the total length of the two following joints, the other joints are subequal. The bristle of the second joint is about as long as or somewhat longer than the total length of the eight distal joints; it is furnished ventrally with a few — in the two cases investigated there were eight — smooth, powerful secondary spines, sparsely placed, and dorsally it has a corresponding number of short, rather fine, bristles, situated opposite the ventral spines. The proportion between the length of the longest natatory bristles and the whole exopodite is about five to three. The natatory bristles have broad natatory hairs placed close together.

The bristles of the third and fourth joints and the middle one of the three bristles on the end joint are, in addition, furnished, the two former ventrally, the latter dorsally, with a series of very coarse, strong, smooth spines, somewhat blunted and rounded distally (the species has obtained its name from this character); the number of spines on each bristle seems to vary, from twelve to eighteen have been observed; they are so placed that when the natatory bristles are situated closely along each other a single row of spines is formed, in other words, the spines on the bristle of the fourth joint are situated so as to form a direct continuation of those of the preceding bristle and the spines on the bristle of the end joint are a continuation of those of the bristle on the fourth joint; the row of spines on the bristle of the third joint begins a rather long distance from the base of the bristle, the unarmed proximal part of this bristle corresponding in length to about the total length of the five or six distal joints. (This unarmed part is protected by the strong bristle of the second joint). The end joint has only three bristles, of which the two ventral ones are developed in the same proportions as the natatory bristles of the preceding joints; the dorsal one, which also has long, well-developed natatory hairs, situated close together, is about as long as the total length of the eight distal joints. The four distal joints have powerful basal spines; the basal spines on the third to the fifth joints are, on the other hand, very small, especially those on the third and fourth joints, which can only be observed with difficulty. Endopodite (fig. 10): This is short and verruciform, with only an indication of having two joints. Proximally it has three bristles of somewhat different lengths, the longest being comparatively long, more than double the length of the shortest and about as long as the total length of the four distal exopodite joints; they all have short hairs or are almost naked.

Mandible (fig. 11): — Protopodite: The endite on the coxale has a rather moderate number of spines. It is — as has been pointed out above — weakly bifurcated distally, the two distal points are considerably stronger than the spines and are almost quite bare; between these two points there is a verruciform process. The basale has seven bristles ventrally: three a-bristles, one b-bristle, two c-bristles and one d-bristle. Of these the a-, b- and c-bristles are short, the b-bristle being even rather difficult to distinguish, the d-bristle is about as long as the second endopodite joint. At the base of this last bristle there is no short bristle, contrary to what is the case in all the other species of this sub-family that are dealt with in this work. Of the three bristles on the dorsal side the proximal one is fixed at or just behind the middle of the joint and is quite short, being only about a fifth to a quarter of the length of the dorsal side of this joint; the two distal bristles are similarly rather short, one being about as long as the dorsal side of the first endopodite joint, the other twice as long; all these three bristles have short hairs. The exopodite is a good deal shorter than the dorsal side of the first endopodite joint; both its two bristles have short hairs or are almost bare; the longest, the proximal one, is about as long as the longest distal bristle situated dorsally on the second protopodite joint, the distal one is short, about as long as the exopodite. Endopodite: Of the four ventral bristles on the first joint the longest one, which is not quite as long as the posterior side of the second endopodite joint, has numerous long secondary bristles arranged in irregular wreaths, and has short hairs distally; the other three have short hairs. Second joint: This has rather few bristles on the anterior side; these are concentrated on the proximal

third of the joint: seven long bristles with short, fine hairs, their relative lengths varying and somewhat different from each other, the longest being almost as long as to the end joint; in addition to these seven bristles there are only two more short cleaning bristles, of which the proximal one is almost bare, the distal one with a strong double pectination. On the posterior edge, distally of the middle of the joint, this joint has, as is usual in forms belonging to this sub-family, two rather short, bare, spine-like bristles of about the same length, one situated somewhat distally of the other, and near the postero-distal corner there are two additional bristles of the same kind, situated by the side of each other; the medial one of these two bristles is not perceptibly longer and more powerful than the lateral one. The bristles of the end joint (fig. 12) are rather short. The two middle claws are about a quarter of the length of the second endopodite joint, are very powerful and uniformly but rather weakly curved, and have rather few but comparatively powerful secondary teeth posteriorly on the proximal half. The two anterior bristles, which are of about the same length as each other, are somewhat shorter than the middle claws; the medial one of them is developed into a powerful claw of the same type as the latter, the other is rather weak and bare. Of the three posterior bristles, all bare, two are rather weak and about as long as the middle claws or somewhat longer, the other, which is situated most posteriorly, is, as usual, very short. Pilosity: The second endopodite joint has short hairs along the distal part of the posterior side.

Maxilla: — Protopodite: The first endite (fig. 13) is furnished with nine powerful bristles of moderate length, eight of which are subequal and one, one of the outer ones, is somewhat shorter. The three innermost of these bristles have simple points and are furnished with a few oblique wreaths of long, stiff secondary bristles; the distal one of these wreaths continues right to the point of the bristles. Of the rest three, including the short one, are trifurcated distally and three have a powerful simple point; all of them are furnished at the middle with rather few long, stiff secondary bristles and distally with fairly powerful secondary teeth; the secondary teeth are most powerful on the bristles with simple points. The second endite (fig. 14) has seven bristles of moderate length. Of these the inner one is rather powerful, trifurcated distally and is furnished at the middle with a moderate number of long, stiff secondary bristles, distally of which there are a few rather strong spines. The three bristles fixed close to this bristle are subequal and somewhat shorter and considerably weaker than it; they are weakly pectinated distally and one of them has a few long secondary bristles at the middle. The three outer bristles are rather powerful, especially the innermost one of them, subequal and somewhat longer than the other bristles on this process; the innermost one has a few long, stiff secondary bristles at the middle, the rest have no such bristles; all of them are rather strongly pectinated distally. The third endite (fig. 15) has five rather powerful distal bristles, of which the outer one is rather long, the four others being subequal and of moderate length. The outer one has a large number of long, stiff secondary bristles situated close together and is finely pectinated distally. Of the rest the next to the outer one and the inner one have short, fine hairs, almost bare, and the two remaining ones, which are somewhat more powerful than the two former, are rather strongly pectinated distally. The proximal bristle on the outside of this process has short, fine hairs, almost bare, and is about half the length of the outside of this process. The dorso-distal bristle on the coxale is not quite as long as the outer distal bristle

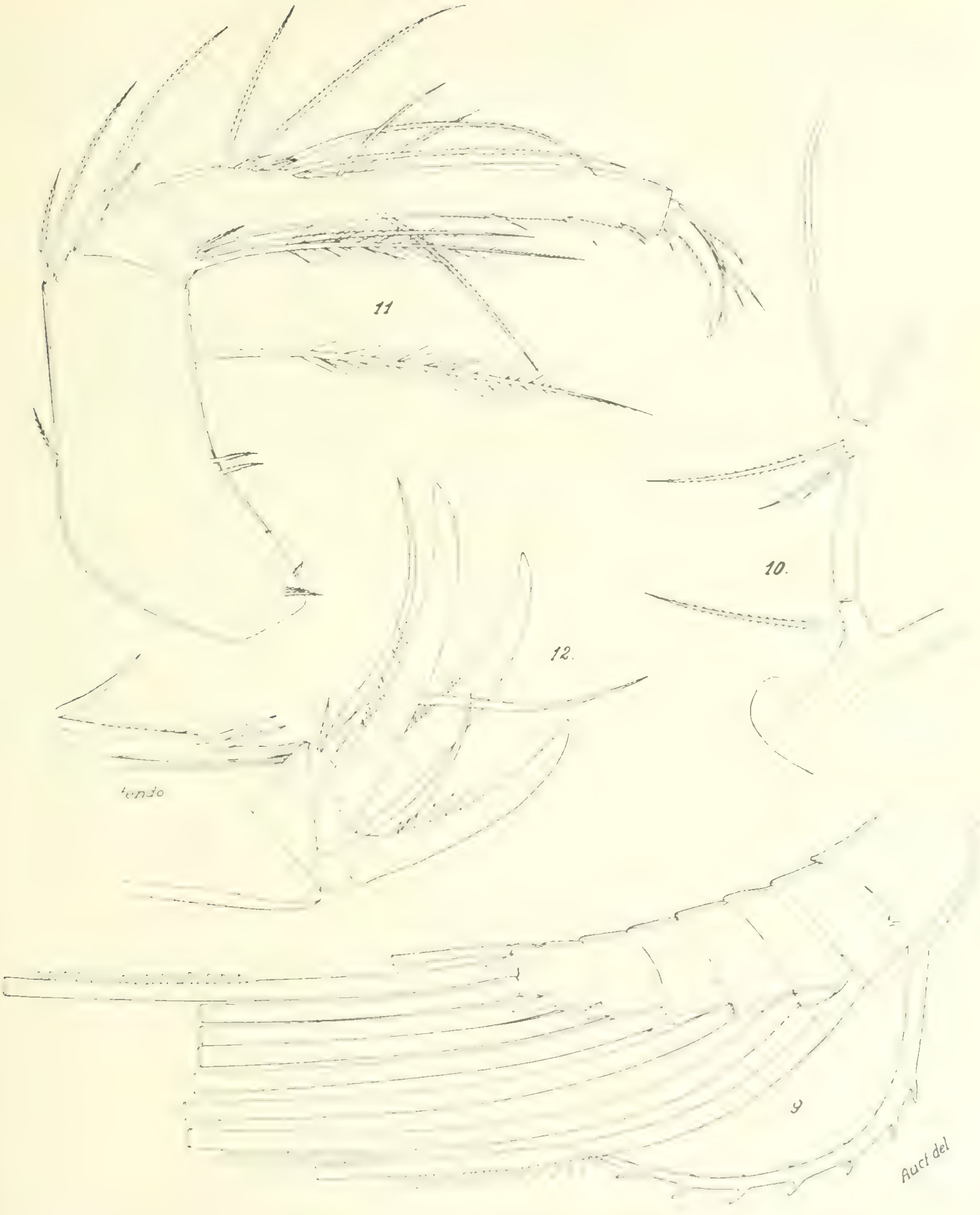

Fig. LIV. — *C. (Siphonostra) spinifera* n. sp., ♀. — 9. The eight distal joints of the exopodite of the right second antenna, seen from outside; the bristles on the seven distal joints are broken, their natatory hairs are not drawn; 312 ×. **10.** Endopodite and distal part of the protopodite of the second antenna; 312 ×. **11.** Left mandible, seen from inside; 192 ×. 12. Distal part of the right mandible, seen from inside; 592 ×.

on the third endite. Of the three bristles on the boundary between the basale and the first endopodite joint the one near the exopodite is about as long as the distal bristles on the exopodite and has short, fine hairs; the one on the anterior edge of the palp is somewhat longer than the dorso-distal bristles on the coxale, the one at about the middle of the inside of the palp is somewhat shorter; these two bristles have short, fine hairs or are almost naked. Of the three bristles on the exopodite the two distal ones are subequal, somewhat longer than this branch and about twice as long as the proximal one; the distal one has short, fine hairs, the other two are plumous. Endopodite (fig. 16): First joint: Distally on the anterior edge there are two rather long bristles with short, fine hairs, the anterior of which is a good deal longer than the posterior one. Distally on the posterior edge there are also two bristles, the posterior one rather long and rather strongly pectinated, the anterior one considerably shorter and weaker and with short, fine hairs distally, almost bare. Close to the two latter bristles the joint has a somewhat pointed triangular process, which projects strongly and is rather strongly chitinized. The end joint is rather strongly chitinized and is furnished with a rather small number of bristles, only ten: three a-bristles of moderate strength and length, bare or almost bare; one b-bristle of moderate length, rather powerful, and rather strongly pectinated; three c-bristles, subequal, rather powerful, of which the two posterior ones are of the same type as the b-bristle, while the anterior one is furnished at the middle with a few powerful secondary teeth; three d-bristles, very powerful and somewhat longer than the former ones, subequal, the posterior one very strongly pectinated distally, the two others with a rather small number of very powerful secondary teeth at the middle. Pilosity: The first endopodite joint has transverse series of short, fine hairs.

Fifth limb: — Protopodite: The first endite (fig. 19) is furnished with six bristles, of which nos. 2 and 4, counting from the anterior side of the limb, are of moderate length and somewhat longer than the other four; no. 1 is short but, judging from the larval specimen investigated, not always as short as shown in the adjoining figure. All these bristles are rather powerful and are furnished with one or a few wreaths of long, stiff secondary bristles. Second endite (fig. 20): The five inner bristles are of moderate lengths; nos. 3 and 4, counting from the anterior side of the limb, are somewhat shorter than the rest. All except no. 3 are furnished at the middle with a wreath of long, stiff secondary bristles. Bristles nos. 1 and 2 are rather powerful and rather weakly pectinated distally, no. 3 is also rather powerful and is sharply serrated distally, nos. 4 and 5 are very powerful and have a few strong secondary teeth distally. The single bristle on the anterior side of this process is short, rather weak and bare. Third endite (fig. 21): Most of its seven bristles are moderately long, the middle ones being somewhat shorter than the outer ones; no. 6, counting from the anterior side, is very short. The six anterior ones are rather powerful, the posterior one is very powerful. Bristles nos. 1 and 7 are furnished with a wreath of more or less long, stiff secondary bristles proximally of the middle; on no. 1 these are, however, rather few in number and weak; all the other bristles are without any such secondary bristles. Bristles nos. 1 and 2 are finely pectinated distally, nos. 3 and 5 are sharply serrated distally, no. 4 is rather strongly pectinated distally, no. 6 has a few powerful secondary teeth distally, no. 7 is very powerfully pectinated distally. The distal chitinous spine of the protopodite is long, narrow and curved. The epipodial appendage has

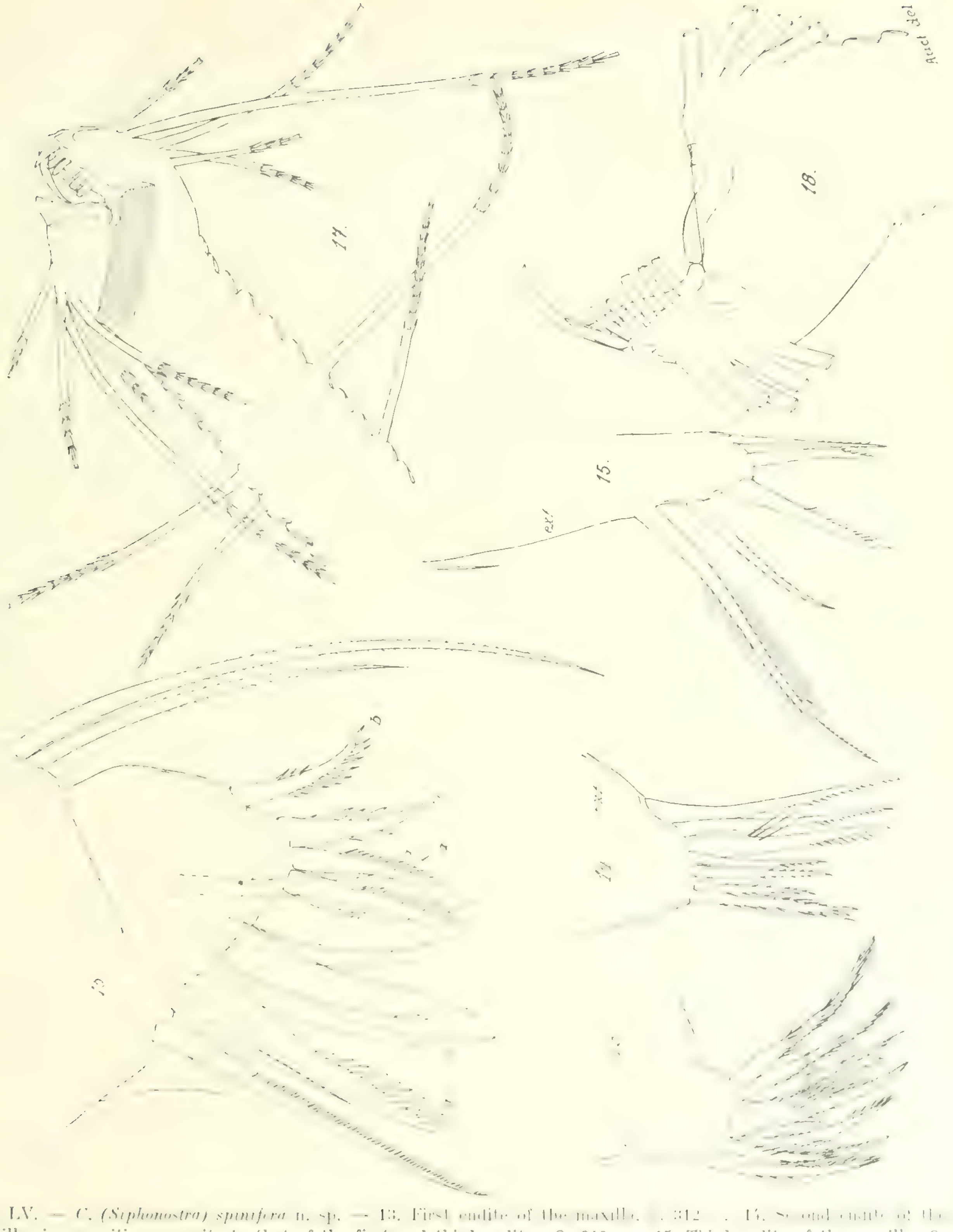

Fig. LV. — C. (*Siphonostra*) *spinifera* n. sp. — 13. First endite of the maxilla, ♀; 312 ×. 14. Second endite of the maxilla; in a position opposite to that of the first and third endites; ♀; 312 ×. 15. Third endite of the maxilla, ♀; 312 ×. 16. Distal part of the endopodite of the left maxilla, seen from inside, ♀; 480 ×. 17. Seventh limb, ♀; 312 ×. 18. Distal part of the seventh limb, all the cleaning bristles broken; from a larva in the last stage; 480 ×.

about fifty to sixty bristles, all with long hairs right out to their points. Exopodite: This has four joints. First joint: The main tooth (fig. 22) consists of six constituent teeth, all well defined proximally, whose secondary teeth are of about the same type as that shown in the accompanying figure. The bristle on the posterior side of this joint, close to the main tooth, is about as long as the anterior constituent tooth of the main tooth, is furnished at the middle with a wreath of long, stiff secondary bristles and is rather strongly pectinated distally or else almost bare. On the anterior side of this joint there are four bristles, three in a row near the main tooth and one farther out. Of these bristles the two situated nearest to the main tooth are rather long and subequal, the one next to the main tooth is powerful and is strongly pectinated distally but has no long secondary bristles, the other one is somewhat weaker and has long hairs at the middle and short ones distally. The two remaining of these bristles are somewhat shorter than the former ones, the inner one being the shortest, and are of about the same type, having long hairs at the middle and short ones distally. The second joint (fig. 23) is furnished with three a-bristles, five b-bristles, one c-bristle and one d-bristle. Of these the a-bristles are very powerful and have very strong secondary teeth, the b-bristles are rather powerful; the c- and d-bristles are of moderate length and of the same type, having long, soft hairs at the middle and short hairs distally. The outer and inner lobes of the third joint, like the end joint, are of moderate size. The inner lobe of the third joint has two distal bristles of moderate length, the outer one has long hairs at the middle and short ones distally, the inner one is bare and somewhat shorter than the outer one; in addition this lobe has a single bristle posteriorly, somewhat more proximally, which is a little shorter than the distal ones and has long hairs at the middle and short ones distally. The outer lobe has two distal bristles of moderate length, the outer one being somewhat shorter than the inner one; both have long hairs at the middle and short ones distally. The fourth joint has three distal bristles of moderate length, one with long hairs at the middle and short ones distally, the two others with short hairs. Pilosity: The outer lobe of the third exopodite joint is partly furnished with fine hairs.

Sixth limb (fig. 24): — Protopodite: The first endite has one rather long and powerful distal bristle, furnished with a few wreaths of long, stiff secondary bristles, and two short, plumous medial bristles. Second endite: This has three distal bristles, two of which are rather long and powerful, furnished at the middle with long, stiff secondary bristles and with short hairs distally, the third, the middle one, is rather short and has long hairs at the middle. This endite has, in addition, two medial bristles, one of which is short and plumous, while the other, which is about as long as the long distal bristles, has long hairs at the middle and short ones distally. Third endite: This has three distal bristles corresponding approximately to those on the former endite, the dorsal one being, however, furnished only with short hairs; in addition there is one medial bristle, of the same type and length as the long medial bristle on the second endite. The epipodial appendage of the protopodite is represented by five unusually long, bare bristles, the distal ones of which are considerably longer than the proximal ones. Exopodite: First joint: The endite has six distal bristles and one medial bristle, of the same types as the bristles on the preceding endite. The second joint is about twice as broad as it is long, and has nine or ten bristles, all situated near the ventral edge; there is no pronounced

Fig. LVI. — *C. (Siphonostra) spinifera* n. sp., ♀. — 19. First endite of the protopodite of the fifth limb; 480 ×. 20. Second endite of the protopodite of the fifth limb; 480 ×. 21. Third endite of the protopodite of the fifth limb; 480 ×. 22. The main tooth of the first exopodite joint of the fifth limb and the adjacent bristles; 480 ×. 23. The distal exopodite joints of the right fifth limb, seen from in front; the pectination is not drawn on one of the posterior b-bristles; 480 ×. 24. Left sixth limb, seen from outside; 312 ×.

gap between the posterior bristles and the others. The two posterior ones are rather long, with long, soft hairs right out to their points. Of the others some are rather long, others are of moderate length or more or less short. Some of them have long hairs at the middle and short hairs distally; the long hairs are not or are only slightly arranged in wreaths; on the posterior ones of these bristles they are soft, on the anterior ones somewhat stiffer. The other bristles, in most cases the shorter ones, have only quite short hairs. Pilosity: This limb is smooth both on the outside and the inside, but has a series of unusually long and powerful hairs along the posterior part of the ventral margin of the second exopodite joint.

S e v e n t h l i m b (figs. 17, 18): — This is of moderate length, slightly longer than half the length of the shell. Cleaning bristles: Distally, situated very close together, there are ten bristles, five dorsal and five ventral ones; of these — both among the dorsal and the ventral ones — the most distal one is rather short, the next distal one relatively long and the rest decrease somewhat in length the more proximally they are situated, the proximal one being rather short. At some distance proximally of these there are four more bristles, two on each side; these are rather long or of moderate length. The cleaning bristles are furnished with from three to eight bells, cut off transversally distally; the tongue of the distal bell is also cut off transversally distally. (Of about the same type as is shown in fig. 25 of *C. (Vargula) norvegica.*) Proximally of the bells the bristles are bare. The end comb consists of a long, very strong, bare central distal tooth, somewhat bent inwards and distally pointed, and three considerably shorter distal teeth and three proximal teeth on each side of the former. The distal one of the three last-mentioned distal teeth is somewhat longer than the two others and is distally pointed, the two others are rounded distally. The dorsal wall of the cavity, dorsally close to the end comb, consists of two somewhat S-shaped chitinous plates, situated by the side of each other, cut abruptly off dorsally and furnished there with a number (about ten) of fine, short teeth.

F u r c a (fig. 8): — This has eight comparatively powerful and straight claws, all well defined from the lamella, except nos. 2 and 4, which are completely joined to it. The claws decrease fairly uniformly in length the more proximally they are situated, except no. 3, which is only about as long as and considerably weaker than no. 4. Proximally of the claws the furca has short hairs.

U p p e r l i p (fig. 7): — The upper glandular field is narrow, almost crest-shaped and has about nine or ten moderately large pegs (the mouths of the glands), of which only a few of the ventral ones are paired. The paired ventral glandular fields are also almost crest-shaped and about as large as the unpaired dorsal one; they have a rather small number of moderately large pegs, a couple of the most posterior of which being somewhat higher than the others. The protuberance situated dorsally of the upper lip is rather large, and has a single point, somewhat rounded.

The m e d i a n e y e is rather well developed. The r o d - s h a p e d organ is missing? (broken off?).

The m a l e is unknown.

Type specimen. *Remarks:* — The type specimen of this species is a female with large eggs in its ovaries. Apart from this specimen I have only investigated a larva, presumably in the last larval stage. This larva agreed in practically every detail with the type specimen.

The situation of the spines on the bristles of the exopodite of the second antenna seems to afford a good support for G. W. MÜLLER's assumption that they are to be regarded as an adaptation for digging.

Equipment of the exopodite of the 2nd antenna.

Habitat: Australia:

Cape Jaubert (type locality), 42 miles W. S. W.; at a depth of about 25 metres; 26. V. 1911 (coll. E. MJÖBERG): one mature ♀, one larva; R. M. S., on slides.

Sub-Genus Cypridina H. MILNE EDWARDS.

Cypridina, H. MILNE EDWARDS, 1840; *Cypridina* (part.), J. D. DANA, 1852; *Philomedes* (part.), G. S. BRADY, 1880; *Pyrocypris*, G. W. MÜLLER, 1890, 1912 etc.; *Eupathistoma*, G. S. BRADY, 1898. (Non *Cypridina* J. BOSQUET, SCHRENK and other authors on fossil Ostracods.)

Description: — Shell: — The shape is similar or somewhat, in most cases, however, rather slightly, different in the male and the female. It is rather elongated. The rostrum has always a distinct ventral corner; the rostral incisur is comparatively narrow and moderately deep, sometimes even rather shallow. The posterior part of the shell has a well-developed beak-shaped process. Near the inner edge of the incisur there are two medial bristles situated close to each other, at least in most of the species. Calcification? The forms are moderately large, all of them being about 2 mm. in length.

First antenna: — This is long and slender and has seven or eight joints; the fifth and sixth joints seem in most cases to be more or less joined together; the joining is sometimes even complete; the small end joint also seems sometimes to be not quite distinctly defined. The sensory bristle of the fifth joint has comparatively few (always less than thirteen?) filaments. The b-bristle has precisely the same modification in the males as in the sub-genus *Doloria*. Note that in the female of the only species of this sub-genus that I have had an opportunity of investigating this bristle had no filaments at all. The c-bristle is characterized by having, apart from the proximal filament with only one sucker, only one, not two, filaments with suctorial organs; in other respects this bristle is also like that of the sub-genus *Doloria*. The small suckers on bristles b and c are very weakly developed. In the males the e- and f-bristles are very much longer than in the females.

Second antenna: — Protopodite: This has a medial-distal bristle. Exopodite: The bristle of the second joint is rather weakly developed. The natatory bristles on the third to the ninth joints are quite without spines. The third to the ninth joints have basal spines. Endopodite: This is similar in the male and the female and is very much reduced; it is verruciform; the distal (sensory?) bristle is comparatively short.

Mandible: — Protopodite: The endite on the coxale is rather weakly bifurcated distally; its spines are moderately strong or else weak and have no distinct arrangement

in groups. Apart from the bristle of the endite this joint is quite without bristles. Basale: Of the ventral bristles one d-bristle is very long; it has a moderate number of long secondary bristles arranged in irregular wreaths and has short, fine hairs distally; the rest, most of which are short, have short hairs or are bare. Dorsally this joint has three bristles. Endopodite: The first joint has four bristles ventrally. The end joint has seven bristles, the two middle ones of which are rather powerful, claw-shaped, of about equal length and strength.

Maxilla: — Protopodite: Dorso-distally the coxale has a single bristle with long, fine hairs. The proximal bristle on the outside of the third endite, which is always developed in other closely-related sub-genera and genera, does not seem to be developed. On the boundary between the basale and the first endopodite joint there are two bristles, one situated close to the exopodite and the other at about the middle of the inside of the palp. Dorso-distally on the coxale there is a rather large, somewhat lamelliform epipodial appendage. The exopodite is comparatively well developed and has fine, long hairs situated close together; it is not displaced distally. The endopodite is broad and moderately long.

Sixth limb: — The second exopodite joint is rather short and somewhat rounded, with comparatively few bristles. Its posterior bristles are not strikingly larger than the others.

Seventh limb: — This is furnished with very few, ten at most, cleaning bristles, some of which are concentrated distally, the others situated irregularly more proximally; with regard to the latter it may be mentioned that there is never more than one bristle on the same side of the same joint. The end comb consists of a comparatively small number of teeth, all of one kind, the distal ones often being exceedingly long, the proximal ones short. Dorsally close to the end comb the wall of this limb is only weakly or not at all thickened and only quite weakly concave. Although there is no special adductor, it seems as if this concavity can be compressed somewhat (like a jaw), as I have sometimes seen in preserved material the teeth of the end comb pressed inwards.

Furca: — The lamellae are moderately elongated. There are nine claws, which show no or rather slight signs of division into main claws and secondary claws.

The upper lip is very characteristic for the genus. It is rather large and has six processes, of which the two anterior ones are unpaired and the other four paired. The posterior two are shaped like fingers, the others are verruciform, but are, however, at least as long as they are broad proximally. These processes include the openings of the very strong glands of the upper lip, which secrete a luminous matter. (The two unpaired dorsal ones correspond to the dorsal field of glands in closely-related forms, just as the ventral ones do to the two paired ones?)

The rod-shaped organ is rather short and thick.

The lateral eyes are well developed.

All the species are distinguished by their strong phosphorescence. They rise to the surface of the sea at nights.

Tropical seas: Indian and Pacific Oceans.

The name of the sub-genus.

Remarks: — The name *Cypridina* has formerly been used for many heterogeneous elements belonging to the sub-order *Cypridiniformes*.

In the present work, on the other hand, this name is used for a smaller group which is well defined systematically, a group that in recent works has appeared under quite different names. The following facts may probably show that this change of name is well grounded.

The first author to denominate and describe scientifically a species belonging to the subfamily *Cypridininae* — thus at the same time the first species belonging to *Cypridiniformes*, cf. p. 165 above — was H. MILNE EDWARDS. In a work that this author wrote in collaboration with G. P. DESHAYES, published in 1838, there is mentioned cursorily on p. 178 an Ostracod which differed so greatly from all the other forms of this group that were known at this time — the genera *Cypris* and *Cythere* — that it seemed necessary to the former author to present it as a representative of a new genus „sous le nom de Cypridines". The „description détaillée" of this form that is promised in this work is to be found in MILNE EDWARDS's work „Histoire naturelle des Crustacés", vol. III, 1840, p. 410. Unfortunately this description is anything but „détaillée"; on the contrary it is very incomplete; at any rate it does not permit of a certain identification of the species.

Is it possible to identify this species of MILNE EDWARDS' — *Cypridina Reynaudi* — generically, or, to express it perhaps in a better way, to which species or group of species now known is this species most closely related?

In other words which forms ought now to have the name *Cypridina*?

G. W. MÜLLER, 1912, p. 52, includes this species under the heading: „Cypridinidarum genera dubia et species dubiae", thus indicating that it is unidentifiable both as a species and as a genus. — This may perhaps, however, be a rather premature step.

W. LILLJEBORG writes, 1876, p. 4: „Genom Professor S. LOVÉNS godhet har jag blifvit i tillfälle att taga kännedom om en i Indiska Oceanen tagen och för sin förmåga att lysa i mörkret särskildt anmärkt Cypridinid — utan tvifvel lefvande i ytan af hafvet — som sannolikt är af samma art som MILNE EDWARDS' *Cypridina Reynaudi*, och som således torde kunna betraktas som typ för det af samme författare uppställda släktet *Cypridina*."* This statement of LILLJEBORG's has up to now been neglected by writers on this subject presumably on account of its being written in Swedish.**

LILLJEBORG does not give any figure or detailed description of the specimens of this form investigated by him. Merely from a number of statements in the text there can, however, be very little doubt that they belonged to the group of species that later on, in 1890, was distinguished by G. W. MÜLLER as a new genus under the name *Pyrocypris*. I have also been able to verify this assumption by an examination of LILLJEBORG's original preparations.

Whether W. LILLJEBORG's identification of the species is correct is a question which may be quite impossible to decide. On the other hand it is very likely that *Cypridina Reynaudi*

* Translation: „Owing to Professor S. LOVÉN's kindness I have had the opportunity of becoming acquainted with a Cypridinid caught in the Indian Ocean and specially notable because of its power of shining in the dark. It undoubtedly lives near the surface of the sea and is probably of the same species as MILNE EDWARDS' *Cypridina Reynaudi* and thus may be looked upon as the type of the genus *Cypridina* which was established by the same author."

** This find was also mentioned by W. LILLJEBORG, 1853, p. 170.

belongs to the above-mentioned genus *Pyrocypris*, although even on this point it may be impossible to get full evidence.

This assumption is supported by the following reasons:

First there is the fact that *Cypridina Reynaudi* has the same characteristically elongated type of shell as distinguishes *Pyrocypris*.

Secondly there is nothing in MILNE EDWARDS's description against this identification, apart, of course, from statements that are obviously due to mistakes in observation on the part of this author, such as, for instance, the absence of the rostral incisur.

In addition, a reason that is — in my opinion — rather strong is to be found in the statement as to the locality of the find: The species in question was captured in the Indian Ocean. — Several species of *Pyrocypris* occur in this ocean, some of them even in enormous numbers. As an example of this it may be mentioned that no less than 20 000 specimens of *P. Chierchiae* were caught in these regions in a single haul (G. W. MÜLLER, 1890, p. 232). To this it may be added that species of this group attract attention by their intense phosphorescence, and, on account of their pelagian life, are very easy to catch, reasons that must of course be taken into account when we are dealing with a form that was apparently captured quite accidentally.

On the other hand, of all the specimens to which G. W. MÜLLER, 1912 etc. and other authors applied — apparently arbitrarily — the name *Cypridina*, it may be said with very great probability that they are not closely related to *Cypridina Reynaudi*.

As no other forms either — except those belonging to *Pyrocypris* — are known so far, which can with any great probability be considered as closely related to the species described by MILNE EDWARDS, it seems to me justifiable and convenient to use the name *Cypridina* for the last-mentioned group of forms.

As the type species of this sub-genus it may be convenient — in accordance with the above-quoted statement — to take the species investigated by W. LILLJEBORG. Identifiable material of this form (four specimens) is still preserved in the collections of the Zoological Museum of the University, Uppsala.

It may, on the other hand, not be appropriate to give this species the name *Reynaudi* MILNE EDWARDS; LILLJEBORG's identification is evidently too uncertain. — Do the specimens investigated by LILLJEBORG belong to a species that has been mentioned and described later? As far as I can decide, they seem to belong to *Pyrocypris inermis* G. W. MÜLLER. I cannot, however, be quite certain on this point on account of the incompleteness of this species of MÜLLER's.

If my identification is correct, *P. inermis* would thus be coveniently taken as the type species of the sub-genus *Cypridina*.

Diagnosis of the sub-genus. In G. W. MÜLLER's diagnosis of the genus *Pyrocypris* it is stated (both in 1906 b, p. 16 and 1912, p. 16) that the equipment of the distal bristles of the male first antenna in this group agrees with that in the genus *Cypridina* (sensu MÜLLERI), and also that the endopodite of the second antenna is furnished with four or five bristles. — With regard to the former character it is to be noted that in the sub-genera *Vargula*, *Macrocypridina* and *Cypridinodes*, in other

words in the groups identical with *Cypridina* (sensu MÜLLERI) the c-bristle of the male first antenna has two filaments with small suctorial organs distally, while in the sub-genus *Cypridina* (sensu meo), i. e. *Pyrocypris*, this bristle has only one such filament. With regard to the latter character I only wish to point out that, at least in some species, six bristles are to be found on the endopodite of the second antenna in this sub-genus.

Number of species

Fifteen species of this sub-genus are known so far.

A contribution to the synonymy of C. Chierchiae.

In passing I may make a contribution to the synonymy of a species belonging to this sub-genus.

In G. S. BRADY's work of 1902 a we find on p. 186 that *C. (Cypridina) Chierchiae* (G. W. MÜLLER) was caught in the „Bay of Bengal" by the „G a l a t h e a" expedition. The specimens on which this statement is based are preserved in the Zoological Museum of the University of Copenhagen and have been re-examined by me. The following facts are the results of this investigation:

Firstly the locale stated by G. S. BRADY is a little incorrect. The correct habitat is lat. 6° 22′ N., long. 75° 54′ E., i. e. somewhat S. W. of Cape Comorin in India.

Secondly I discovered that BRADY's identification is incorrect. The characters in the „G a l a t h e a" specimens that do not agree with the information given by G. W. MÜLLER for *C. (C.) Chierchiae* are as follows:

S h e l l: The anterior part of the ventral margin, behind the rostral incisur, has from ten to twelve bristles.

S e c o n d a n t e n n a: The endopodite has six bristles.

M a n d i b l e: The longest of the (four) ventral bristles of the first endopodite joint is rather considerably longer than the others (it is about the same length as in *C. (C.) serrata affirmans*, cf. below).

The s e v e n t h l i m b has six distal bristles, three on each side.

All the limbs are without pigmentation except the left first antenna.

(It is, however, not impossible that a number of these differences are only apparent, as G. W. MÜLLER's description of *C. (C.) Chierchiae* is very deficient.)

To which species do these specimens belong? — I do not consider it convenient to express an opinion on this question. In any case the answer would be very uncertain, partly on account of the very damaged condition of the specimens in question, partly and not least on account of the deficiencies in most of the descriptions of species belonging to this sub-genus.

Cypridina serrata (G. W. MÜLLER) var. affirmans n. var.

Description: — M a l e:

S h e l l: — Length, 1,7—1,75 mm. Length : height, about 1,9 to 1. S e e n f r o m t h e s i d e (fig. 1) it is of about the same shape as that of the type species, but the ventral margin seems to be somewhat more boldly arched. (The shells investigated by me were all soft and consequently their shape was somewhat uncertain.) The s u r f a c e o f t h e s h e l l

is smooth, practically entirely without bristles. Seen from inside: The medial bristles are about the same as in the type species. On the rostrum there are from seven to eleven bristles, simple or weakly bifurcated; the ventral ones of the series are not fixed on a verruciform swelling. Inside the incisur there is, apart from the two bristles that are situated close together near its inner edge, generally only a short, simple bristle near the joining line. The bristles on the list are most frequently simple; they decrease in number towards the back and seem to disappear entirely along the posterior part of the ventral margin. All the medial bristles are quite or almost quite bare. The spines along the list inside the posterior margin of the shell are almost the same as those of the type species. On the right valve they are large, decreasing rather slightly in size ventrally and varying somewhat in number, from fifteen to eighteen; of these the two ventral ones were very small in one case, in two cases only the most ventral one was very small. On the left valve the spines are very small and difficult to verify, some of them even seem to be missing. That part of the list which has spines has, in addition, a few — in most cases about one or two for each spine — short and exceedingly fine bristles. The part between the list and the margin of the shell is of about the same type as in the type species. The selvage is rather wide along the anterior margin of the rostrum, but is narrow along the posterior rostral margin; along the posterior margin of the rostral incisur it is very wide, filling the whole incisur; it continues along the whole ventral margin of the shell, extending rather considerably beyond the latter except at one part just in front of the middle, where it is rather narrow.* At the last-mentioned part it is characterized by the fact that its edge is closely and finely serrated, the edge of the remaining part is almost even. In the incisur the selvage is rather strongly cross-striated, at the remaining part the cross-striation is exceedingly fine.

First antenna (fig. 4): — This has seven joints; the fifth and sixth joints are practically entirely joined (the original boundary, shown in the accompanying figure, can only be verified with difficulty). The approximate proportions between the joints are:

$$\mathrm{I}\,\tfrac{21}{17};\ \mathrm{II}\,\tfrac{27}{25};\ \mathrm{III}\,\tfrac{13}{9};\ \mathrm{IV}\,\tfrac{13}{9};\ (\mathrm{V}\,\tfrac{8}{13};\ \mathrm{VI}\,\tfrac{3}{4});\ \mathrm{VII}\,\tfrac{3}{2};\ \mathrm{VIII}\ 0{,}5.$$

Third joint: The bristle on the anterior side is fixed at about the middle of the joint and is about half as long as the anterior side of this joint. The posterior distal bristle is nearly as long as the total length of the posterior sides of the two following joints or else a little shorter. The anterior bristle of the fourth joint is quite short, scarcely half the length of the anterior side of this joint, the posterior one is somewhat longer, about as long as the posterior side of this joint. The sensory bristle of the fifth joint is somewhat longer than the anterior side of the second joint. It has eleven bare sensory filaments, situated in about the positions indicated in the accompanying figure; the eight proximal ones are somewhat thick in proportion to the distal ones, and are relatively long, being about a third to a half of the whole length of the bristle; the two following filaments are narrow and only about a fifth of the length of the bristle; the distal one is very short, almost verruciform. The bristle of the original sixth joint and the a-bristle of the original seventh joint are subequal, rather short, being only about as long as the original sixth joint. These bristles, like those of the third and fourth joints, have short, fine

* This is not shown in the drawing; in this specimen the selvage was directed somewhat inward.

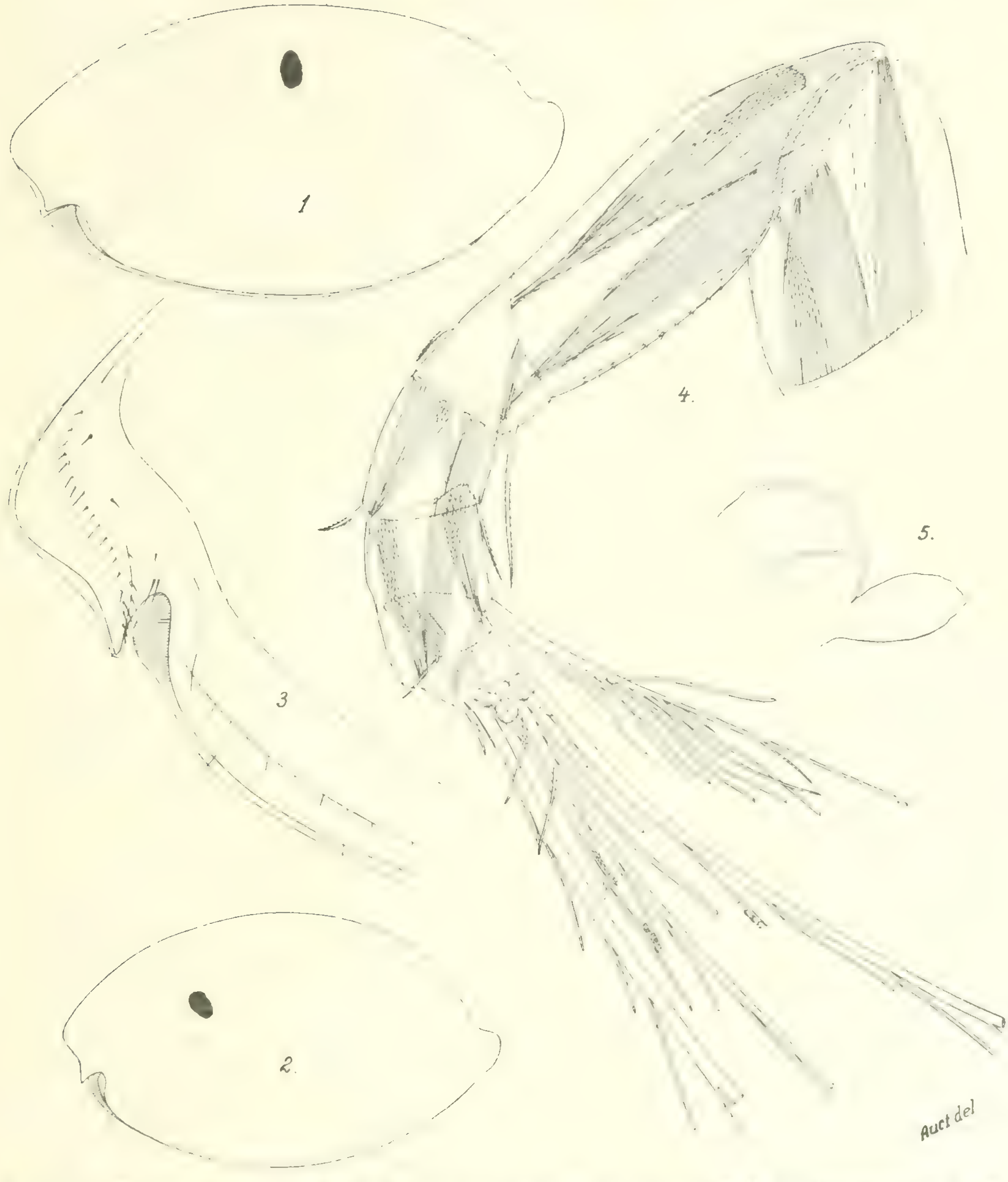

Fig. LVII. — C. [illegible] G. W. Müller [illegible] attenuata, n. sp. — 1. Shell, seen from the outside, ♀: [illegible] ×. 2. Shell, seen from the outside, [illegible]: 53 ×. 3. Anterior part of the right valve, seen from inside, [illegible]: 166 ×. 4. Right first antenna, seen from inside. The [illegible] 4 and 5 bristles are broken, ♂: 175 ×. 5. Median eye and rod-shaped organ, ♂: 275 ×.

hairs. Of the distal bristles the b-bristle is about as long as the anterior side of the second joint or somewhat shorter; its proximal filament is furnished with a chitinized verruciform swelling distally of the sucker (like *C. (Vargula) norvegica*; see fig. 15 of this species). Apart from this filament there are on this bristle only two others, each furnished distally with five small, weak suctorial organs and proximally of these a small verruciform process; the distal one of these filaments does not reach the point of the bristle. The c-bristle has ten filaments; the proximal one of these is about the same as the proximal one on the b-bristle, no. 3, counting from the base, is about as long as or only slightly longer and more powerful than the following ones and has distally three very small and weak suctorial organs, proximally of which there is, as in the b-bristle, a small wart; the other filaments on this bristle are furnished proximally with from no to three very fine, secondary spines; the distal filament is very short and verruciform. The f-bristle also has ten filaments, furnished with up to three short, fine secondary spines proximally; the distal one of these filaments is verruciform. The c- and f-bristles are subequal and rather considerably longer than the whole length of the shell (measuring from 2 to 2,1 mm. in specimens with a length of shell of 1.72 mm.).* The g-bristle, which has eleven filaments, whose proportions and equipment are about the same as the filaments on the f-bristle, is not quite so long as the whole antenna. The simple sensory bristles d and e are somewhat different in length, the longer one, the d-bristle, being about as long as the total length of the four distal joints (the original fifth and sixth joints being reckoned as one joint). Pilosity: On the posterior side of the second joint there are numerous transverse rows of short, stiff hairs (only faintly indicated in the accompanying figure); this character seems, however, to vary to some extent; in one of the specimens investigated these hairs were practically completely reduced. The other joints are smooth.

Second antenna: — Protopodite: Length, about 0,65 mm. The medial distal bristle (fig. 6) has short hairs; it is moderately long, being about as long as the distal sensory bristle of the endopodite. Exopodite (fig. 7): This has about the following proportions between its joints:

$$I : II : III : IV : V : VI : VII : VIII : IX = 28 : 10 : 6 : 4 : 4 : 3 : 3 : 3 : 2.$$

In other words the first joint is about as long as the total length of the five following joints, the second is about that of the two following ones. The bristle of the second joint is only as long as the total length of the three following joints or somewhat shorter; it is furnished ventrally with a few, about seven to ten, rather strong spines. The longest natatory bristles are somewhat longer than the exopodite; the proportion between these two lengths is about 85 : 70. The natatory bristles have broad natatory hairs. The end joint has only three bristles, of which the two ventral ones are long, powerful natatory bristles, developed to the same extent as those on the preceding joints, the dorsal one is only about as long as the total length of the four distal joints and has short, fine hairs. The third to the ninth joints have narrow and relatively short basal spines, which decrease in strength the more proximally they are situated, the one on the third joint being almost completely reduced. The endopodite (fig. 6) is unjointed and

* In this species I have observed, as G. W. Müller previously did for other species (cf. G. W. Müller, 1906 b, p. 16), that in a state of rest these bristles are bent posteriorly upwards along the dorsal side of the body inside the shell.

Fig. LVIII. — *C. (Cypridina) serrata* (G. W. MÜLLER) var. *africana* n. var., ♂. — 6. Exopodite and the distal part of the protopodite of the second antenna; 325 ×. 7. Distal part of the exopodite of the left second antenna, seen from outside; 292 ×. 8. Right mandible, seen from inside; 250 ×. 9. Endite on the coxale of the right mandible, seen from inside; 708 ×. 10. Distal part of the right mandible, seen from inside; strongly compressed; 525 ×.

has six bristles; of these the one situated farthest back, which is very like and obviously corresponds to the long distal (sensory?) bristle on the end joint of the endopodite in other forms, is moderately long, being about as long as the total length of the three distal joints of the exopodite; it is somewhat shorter than the nearest of the remaining bristles, which, like the others, is of the ordinary type with short, fine hairs. These remaining five bristles decrease almost uniformly in length the more anteriorly (and proximally) they are situated and correspond presumably to the five bristles on the first endopodite joint in closely related genera and sub-genera.

M a n d i b l e (fig. 8): — P r o t o p o d i t e: The endite on the coxale (fig. 9) has comparatively few spines, mostly relatively short; its two distal points are rather considerably more powerfully developed than the spines, and, unlike the latter, they are furnished with weak secondary spines; between these two points there is a rather low point; cf. remark on p. 182 above. Basale: This has seven bristles ventrally: two a-bristles, one b-bristle, two c-bristles and two d-bristles. Of these the two a-bristles, the b-bristle and one of the c-bristles are very short, and also one of the d-bristles is rather short; the other c-bristle, on the other hand, is relatively long, longer than the height of this joint; the longest d-bristle is not as long as the posterior side of the second endopodite joint. Of the three dorsal bristles of this joint the proximal one is fixed at rather a long distance in front of the middle of the joint and is about half the length of the joint; of the two distal bristles one is about as long as the former bristle, the other is somewhat longer; all three have short hairs. The e x o p o d i t e is about as long as or slightly longer than the dorsal side of the first endopodite joint. Of its two bristles, both of which have short hairs, one is somewhat shorter and the other somewhat longer than this branch. E n d o p o d i t e: The four ventral bristles of the first joint all have short hairs; the two longest of them, which are somewhat different in length, are relatively short, considerably shorter than the posterior side of the second endopodite joint. The second joint has comparatively few bristles along the proximal half of the anterior side: seven more or less long bristles with short hairs, — their relative lengths vary to some extent, — and four or five short cleaning bristles with rather strong double pectination distally. On the posterior side, distally of the middle, this joint has two short, bare or almost bare bristles, one situated somewhat distally of the other; one specimen, cf. fig. 8, had only one of these bristles developed on the right mandible. Distally of these bristles there are two more bristles, situated at the side of each other, generally rather considerably shorter and weaker than the former ones; the medial one of these is somewhat, though only slightly, longer and more powerful than the lateral one. Of the seven bristles on the end joint (fig. 10) the two middle ones, the main claws, are about a third of the length of the second endopodite joint. Of the two anterior ones the medial one is powerful, claw-shaped and rather slightly shorter than the main claws; it is also distinguished by the fact that its anterior edge has a sort of hyaline border or casing; the other of the anterior ones is weak and is only a little more than half the length of the former one. Of the three posterior bristles one is about as long as the main claws, but somewhat weaker, one is weak and about as long and as strong as the shorter of the two anterior ones, the third is exceedingly short. All the bristles of the end joint, except the anterior claw, have weak posterior secondary teeth. Pilosity: On the inside of the

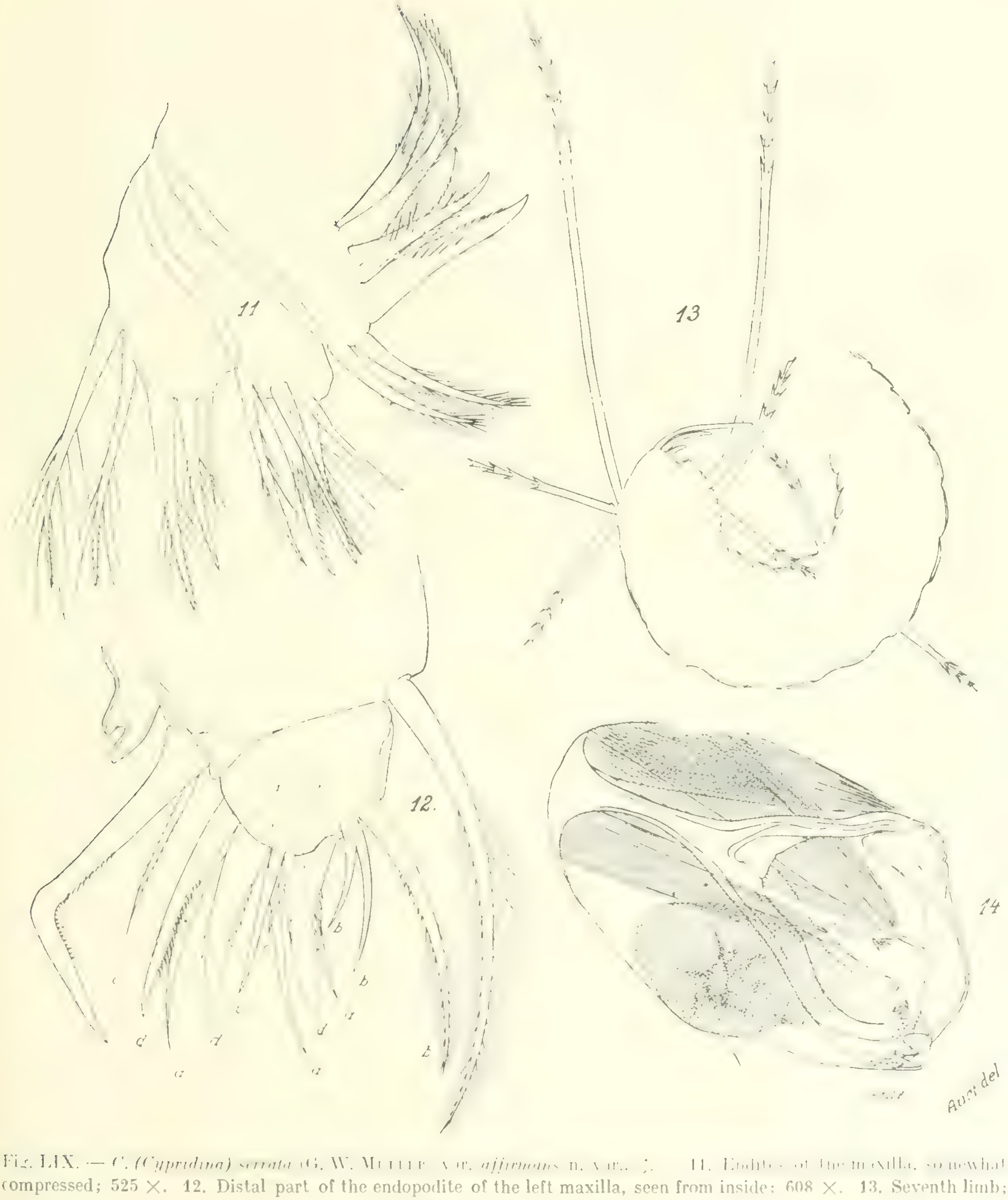

Fig. LIX. — C. (*Cypridina*) *serrata* (G. W. Müller) var. *affirmans* n. var., ♂. 11. Endites of the maxilla, somewhat compressed; 525 ×. 12. Distal part of the endopodite of the left maxilla, seen from inside; 608 ×. 13. Seventh limb; 571 ×. 14. Right penis, seen from outside; 292 ×.

second protopodite joint and the second endopodite joint there are groups of short, fine hairs, and dorso-distally on the first endopodite joint there are also a few short hairs.

Maxilla: — Protopodite (fig. 11): The first endite is furnished with seven powerful bristles of moderate length. Of these the two inner ones are subequal and furnished with a few oblique wreaths of long, stiff secondary bristles; the distal one of these wreaths continues right to the point of the bristles. The other five are subequal and somewhat shorter than the two inner ones; of these five the two outer ones are furnished with rather numerous long, stiff secondary bristles and are trifurcated distally; the other three, one of which is very powerful, are furnished with rather few long, stiff secondary bristles, distally of which there are some short secondary teeth, and have a simple point. The second endite has five rather strong subequal bristles. Of these the inner one has short and exceedingly fine hairs or is bare, one is only rather weakly pectinated distally and the three others have at the middle a few long stiff, secondary bristles and are pectinated distally; on the one next to the outer one the pectination is rather strong, on the two others it is rather weak. The third endite has also five rather powerful distal bristles, all of about the same length except the inner one, which is rather short and weak. The last-mentioned bristle has short and exceedingly fine hairs or is bare; of the other four, all of which have a few stiff, secondary bristles at the middle, the inner one is bare distally, the others are rather weakly or very weakly pectinated distally. The dorso-distal bristle on the coxale is about as long as the outer bristle on the third endite. Of the two bristles on the boundary between the basale and the first endopodite joint the one that is situated near the exopodite is about a third of the length of the bristles of the exopodite, the other is still shorter; both are bare. Of the three bristles of the exopodite the distal one is bare, the two others are plumous; all of them are of about the same length as this branch. Endopodite: First joint (fig. 12): Distally on the anterior edge there is a single rather long, plumous bristle. Distally on the posterior edge there are two bristles, one of which is long and powerful, furnished at the middle with rather weak secondary teeth and characterized especially by being bent at almost a right angle somewhat distally of half its length, the other is considerably shorter and weaker and has short, fine hairs. Proximally of these two bristles the edge of the joint is characterized by a strongly projecting, distally bifurcated verruca. The end joint is rather strongly chitinized and has only eleven bristles: three bare a-bristles of moderate length and strength; three b-bristles, of which the anterior one is moderately long, rather strong, furnished at the middle with a few weak secondary teeth and plumous distally, the two others are naked, weak and short, their lengths being somewhat unlike, the shorter one not quite half as long as the anterior one; two c-bristles of the same type and sizes as the short b-bristles, the anterior one being the shorter, and three d-bristles, subequal, very powerful, especially the two anterior ones, the posterior one rather strongly pectinated, the two anterior ones furnished at the middle with rather few fairly strong secondary teeth. Pilosity: The first endopodite joint has transverse series of short, fine hairs.

Fifth limb: — Protopodite: The first endite (fig. 15, ♂ = ♀) is furnished with only five bristles. Of these bristles no. 1, counting from the anterior side of the limb, is very small, furnished in most cases with long, stiff secondary bristles. The others are of mode-

rate length, mostly decreasing somewhat in length the more posteriorly they are situated. Bristles nos. 2 and 3 are of the same type, rather powerful and furnished with two or three oblique wreaths of long, stiff secondary bristles; the distal one of these wreaths continues right to the point of the bristles. Bristles nos. 4 and 5 are very powerful and are furnished at the middle with one or a few wreaths of long, stiff secondary bristles, distally with a few powerful secondary teeth; these are most powerful on the first-mentioned bristle, on no. 5 they may even be entirely absent. Second endite (fig. 16, ♂ [illegible]): Of the five inner bristles nos. 1 and 5, counting from the anterior side of the limb, are furnished at the middle with a wreath of long, stiff secondary bristles, the other three have no such bristles. The three anterior ones are rather powerful and of moderate length, nos. 2 and 3 somewhat shorter than no. 1; the latter bristle is rather weakly pectinated distally, no. 2 seems to be quite bare (even with as strong magnification as REICHERT's ocul. 4, LEITZ' immers. $^1/_{12}$), no. 3 is sharply serrated distally. No. 4 is only represented by a small, powerful, conical, bare chitinous spine; no. 5 is moderately long, very powerful and has, distally of the wreath of secondary bristles, a few powerful spines. The bristle on the anterior side of this process is short and has short hairs. The seven bristles of the third endite (fig. 17, ♂ [illegible]) are of the same types as the five inner bristles on the second endite. Bristles nos. 1, 2 and 6 on the third endite, counting from the anterior side of the limb, are very like bristles nos. 1, 2 and 4 on the second endite; bristles nos. 3 and 5 on the former endite are like bristle no. 3 on the latter; the posterior bristle on the third process differs from the same bristle on the second only by having more secondary teeth distally; bristle no. 4 on the third endite is rather strongly pectinated distally, it is usually quite without long secondary bristles. The e p i p o d i a l p l a t e has from about thirty to forty bristles, all furnished with long, soft hairs almost to their points. The protopodite has no distal chitinous spine at all, which is specially noteworthy because a spine of this sort is developed on all the other species of this sub-family that are dealt with in this work, as has been pointed out above, p. 185 in the description of this sub-family. The e x o p o d i t e has four joints. First joint: The main tooth (fig. 18, ♂ [illegible]) consists of seven constituent teeth, the anterior one of which is relatively somewhat stronger than in the other forms of this sub-family that I have investigated, and, contrary to these, is completely united to the joint; the secondary teeth of the constituent teeth are comparatively weak. The bristle on the posterior side of the joint near the main tooth is about as long as that of the anterior constituent tooth from the point where the second constituent tooth is situated and may or may not have long hairs at the middle, distally it has short hairs. On the anterior side of the joint there are three bristles, two situated near the main tooth, one somewhat farther out on the joint. Of the two former ones one is rather long and powerful, its point reaches about as far as the point of the anterior constituent tooth; it is strongly pectinated distally and has at the middle a wreath of long, stiff secondary bristles. The other is only a little more than half the length of this one, rather weak, furnished with a wreath of long stiff secondary bristles at the middle and short hairs distally. The outer bristle on this joint is somewhat longer than the last-mentioned bristle and has long, soft hairs at the middle and short hairs distally. The second joint has three a-bristles, three b-bristles, one c-bristle and one d-bristle. The a- and b-bristles are moderately long and strong, the outer b-bristle is often

distinguished by being furnished at the middle with a wreath of long, stiff secondary bristles, contrary to what is usual in bristles of this group. The c- and d-bristles are of about the same type as each other, with close long, soft hairs at the middle and short hairs distally; both are moderately long, the former somewhat shorter than the latter (about the same as in figure 22 of *C. (Vargula) norvegica*). The two lobes of the third joint (fig. 19, ♂ ♀) are of moderate size, like the end joint. The inner lobe of the third joint has distally two moderately long bristles with short hairs or bare; proximally-posteriorly it has a single bristle, which is somewhat shorter than the distal ones and which has long hairs at the middle and short ones distally. The outer lobe of this joint has two moderately long distal bristles with short hairs or almost naked. The end joint is furnished distally with four moderately long bristles somewhat different in length and with short hairs. The proportion between all the bristles of the two distal exopodite joints seems to be fairly constant and is shown in the accompanying figure. Pilosity: The outer lobe of the third exopodite joint and the end joint are partly furnished with soft hairs placed close together.

Sixth limb (fig. 20): — Protopodite: The first endite has one rather long and powerful distal bristle, furnished with a few oblique wreaths of long, stiff secondary bristles and two short, plumous medial bristles. The second endite has two rather long and powerful distal bristles, of which the dorsal one is somewhat shorter than the other; both are furnished at the middle with long, stiff secondary bristles and with short hairs distally; this endite has, in addition, two short, plumous medial bristles. The third endite has two rather long and powerful distal bristles, furnished at the middle with one or a few wreaths of long, stiff secondary bristles and with short hairs distally; between these two bristles there is a short and somewhat plumous bristle. The epipodial appendage of the protopodite is represented by two rather short bristles with short hairs. Exopodite: The endite of the first joint has two bristles, one rather long and powerful, of the same type as the long distal bristles on the preceding endite, the other rather short, with long hairs at the middle and short ones distally. The second joint has from six to eight moderately long bristles, all of which are situated very near the ventral edge; there is a rather pronounced gap between the posterior and the other bristles. The two posterior bristles have long, soft hairs right out to their points; the bristle that is situated nearest to them has soft, long hairs at the middle and short hairs distally; the other three or five bristles are furnished at the middle with long, stiff secondary bristles, arranged in most cases in two very distinct wreaths; distally they have short hairs. Pilosity: On the inside this limb is furnished with fine, short hairs, placed close together; the second exopodite joint has laterally a series of short stiff hairs along the ventral margin.

Seventh limb (fig. 13): — This is weak, almost of a larval structure and very short comparatively, being only about a third of the length of the shell. It is furnished with eight cleaning bristles; six of these, three dorsal and three ventral ones, are situated very close together distally, the two remaining ones are situated somewhat more proximally, one on the dorsal and one on the ventral edge. The bristle situated most distally, both among the dorsal as well as among the ventral ones, is comparatively long, the others are moderately long or rather short. The cleaning bristles are furnished with three or four bells cut off transversally

Fig. LX. — *C. (Cypridina) serrata* (G W. Müller) var. *affirmans* n. var. — 15. First endite of the protopodite of the fifth limb, ♀; 1240 ×. 16. Second endite of the protopodite of the fifth limb, ♀; 1240 ×. 17. Third endite of the protopodite of the fifth limb, ♀; 1240 ×. 18. The main tooth on the first exopodite joint of the fifth limb and the adjacent bristles, ♀; 1000 ×. 19. The two distal exopodite joints of the right fifth limb, seen from behind, ♀; 808 ×. 20. Right sixth limb, seen from outside, ♂; 350 ×.

distally; the tongue of the distal bell is also rather sharply cut off distally (about the same type as is shown in fig. 25 of *C. (Vargula) norvegica*); proximally of the bells these bristles are smooth. The end comb consists of five narrow, bare, rather weak teeth, one central tooth and two teeth placed symmetrically on each side of this. The central tooth is long, not quite so long as the height of the limb, and is rather pointed distally. The two proximal teeth are considerably shorter; the one situated most proximally is the shortest, being only about a quarter or a fifth of the length of the central tooth; distally they are somewhat rounded. The concavity dorsally near the end comb has on its dorsal edge a reduced verruciform process.

Penis (fig. 14): — This is of the type that is characteristic of the sub-family. See the accompanying figure for details. A very large gland situated ventrally in the penis has its exit on the ventral process of the pincers.

Furca: — This is of the same type as in the type species. It differs in the two following characters from this as it is represented by G. W. MÜLLER, 1906 b, pl. III, fig. 5: all the claws are furnished with teeth; the second to the fifth teeth on claws nos. 4 to 8 are considerably coarser than the distal ones.

The upper lip agrees with that of the type species.

The rod-shaped organ (fig. 5) of moderate length, rather thick, slightly pointed distally.

The lateral eyes are, as in the case of the type species, situated somewhat above the middle of the shell.

Female: —

Shell: — Length: 1,6—1,7 mm. Lenght: height, about 1,75 : 1. Seen from the side (fig. 2) it shows fairly close agreement with the shape of the shell in the type species, the principal differences being that the ventral corner of the rostrum is somewhat more pointed and that the posterior beak-shaped process is developed rather more powerfully; this process is only slightly smaller than that of the male and has about the same shape. The surface of the shell is similar to that of the male. Seen from inside (fig. 3): Medial bristles: These seem to be somewhat fewer than in the type species; their number seems, however, to vary rather considerably. From 14 to 26 were observed on the rostrum (the maximum number is shown in the accompanying figure); these were arranged in two almost parallel rows, the posterior of which, situated along the posterior edge of the rostrum, is very sparse dorsally, sometimes represented at this part by only a few solitary bristles. The bristles on the list behind the rostral incisur are considerably more sparse than is shown in the figure of the type species. On the right valve from 12 to 14 spines of the same type as in the male were observed posteriorly on the list; of these from none to three of the ventral ones were very small. On the left valve the spines may apparently be quite absent. The bristles on the part of the list that has spines seem to be somewhat fewer than in the male.

First antenna: — This, like that of the male, has seven joints; at least in some cases, however, the fifth and sixth joints seem to be less closely united than in the other sex. The joints have about the same relative proportions as in the male and the bristles on the third, fourth and sixth joints and the a-bristle on the seventh joint also show a rather close agreement

with these bristles in the male. The sensory bristle of the fifth joint is of about the same length and type as in the male, but has fewer (six or seven) long, proximal sensory filaments. Of the distal bristles the b-bristle, contrary to what is the case in all other forms of this sub-family that are described in this work, is simple, without sensory filaments, of about the same type as the d- and e-bristles; it is about as long as the anterior side of the fourth to the sixth joints. The c- and f-bristles are subequal and about as long as the whole antenna (about 1,1—1,2 mm., thus somewhat more than half the length of the shell; the former has eight, the latter nine or ten filaments. The g-bristle is somewhat longer than the c- and f-bristles and has ten filaments. The distal filament on the three last-mentioned bristles is very short, the others are all of the same type, most of them rather long, furnished with up to three weak spines. The two simple sensory bristles d and e are somewhat longer than in the male. The pilosity is similar to that of the male.

Second antenna: — The protopodite, like the exopodite, is somewhat more weakly developed than in the male; apart from this the two sexes show a very close resemblance with regard to this limb. The proportion between the joints of the exopodite, measured on the same scale as in the male, (cf. above) was as follows (the length of the specimen measured was 1,65 mm.):

I : II : III : IV : V : VI : VII : VIII : IX = 21 : 7 : 4 : 3 : 3 : 3 : 2 : 2 : 1.

From these figures it will be seen that the proportion between the joints is about the same in both sexes, but that, as has been mentioned above, the exopodite is, on the whole, somewhat weaker in the female.

Mandible: — This shows an agreement in details with that of the male. All the specimens investigated had on the posterior side of the second endopodite joint, distally of the middle, two short bristles, one situated somewhat distally of the other, thus agreeing with what we must regard as normal in the males. It may be specially mentioned that the posterio-distal bristles of the joint in question are quite similar in both sexes.

Maxilla: — This agrees with that of the male. It may, however, be noticed that the powerful posterior bristle on the first endopodite joint, which is specially characterized in the male by being bent almost at a right angle somewhat distally of the middle, is only weakly bent in the female; it is also relatively somewhat shorter and has moderately strong pectination distally.

Fifth limb: — Quite like that of the male.

Sixth limb: — Very like that of the male. It differs by the epipodial appendage of the protopodite being represented by four short bristles. The second exopodite joint has seven or eight bristles ventrally, of which the four or five anterior ones are furnished with long, stiff secondary bristles, in most cases arranged in two very distinct wreaths.

Seventh limb: — This is quite similar to that of the male.

Furca: — This is of the same shape as in the type species. All the claws have secondary teeth; the proximal teeth on claws nos. 4 to 8, unlike these in the male, do not differ strikingly from the distal teeth by their size and strength.

The upper lip and the rod-shaped organ are similar to those of the male.

The lateral eyes are, like those of the type species, situated somewhat in front of the middle of the shell and somewhat above half the height of the latter. They are rather smaller than those of the male.

Remarks. — I regard *C. (C.) lepidophora* (G. W. MÜLLER) as the female of *C. serrata* (G. W. MÜLLER). — Descriptions of these two forms are to be found in G. W. MÜLLER's work 1906 b, pp. 20 and 21.

This author has the following remark about the latter species (p. 22): „Während wir sonst die ♀ in der Überzahl finden oder die ♂ ganz fehlen, vermissen wir hier die ♂. Umgekehrt vermissen wir bei *P. serrata* die ♀, und da sich beide Formen in Stat. 99 und 140 in größerer Anzahl nebeneinander fanden, liegt der Verdacht nahe, daß sie als die Geschlechter einer Art zusammengehören. Immerhin unterscheiden sich beide Formen in so zahlreichen Merkmalen, auf welche sich sonst die secundären Geschlechtsmerkmale nicht zu erstrecken pflegen, daß ich mich nicht habe entschließen können, beide in einer Art zu vereinigen, doch wird man bei weiteren Fängen die Frage der Zusammengehörigkeit im Auge behalten müssen."

The fact that in an additional case these two forms — or rather a variety of these two forms — were caught together — there were no other species at all of this sub-genus in this sample — as well as the rather great morphological resemblance has convinced me that it is most in accordance with the facts of the case to connect the two forms in question as males and females of the same species.

As in G. W. MÜLLER's work mentioned above *C. (C.) serrata* is placed before *C. (C.) lepidophora*, the former name must obviously be retained according to the rules of nomenclature.

In describing the posterior part of the shell, as seen from inside, in *C. (C.) serrata* G. W. MÜLLER has obviously confused the right and the left valve owing to a mistake, a fact that has apparently increased the amount of difference between this form and *C. lepidophora*; the same mistake is repeated in his work of 1912. That there is a mistake is shown by the accompanying figures in G. W. MÜLLER's work, which show that *C. (C.) serrata* and *C. (C.) lepidophora*, like the males and females of the form described by me above, agree in this character.

identical with the type species?

The variety described above closely resembles the type species and it does not seem impossible to me that in the future we may find that it must be united with this. As a preliminary, however, it has seemed to me necessary to distinguish it as a separate form. With regard to the differences that exist I need only refer to the description and figures. A number of the differences may possibly be explained as the results of lack of accuracy and care on the part of G. W. MÜLLER.

Habitat: — Australia:

Cape Jaubert, N. W. Australia (type locality); at the surface of the sea; 2. VI. 1911 (coll. E. MJÖBERG): four mature males and five mature females; R. M. S.

Genus Monopia C. CLAUS.

Monopia, C. CLAUS, 1873. *Eumonopia*, C. CLAUS, 1891 b. *Cypridina* (part.), G. S. BRADY, 1865, 1897 and 1902 a; G. W. MÜLLER, 1906 b and 1912. *Cypridinodes* (part.), G. S. BRADY 1902 a.

Remarks: — This genus comprises according to my opinion (cf. above pp. 193) two sub-genera: *Number of sub-genera.*

Monopia C. CLAUS
Cypridinodes G. S. BRADY.

It may probably not be convenient to work out a diagnosis of this genus before a detailed re-examination of C. CLAUS' *Monopia flaveola* — the only representative hitherto known of one of the two sub-genera mentioned — has been carried out. I have, consequently, confined myself in this treatise to an elaboration of a description of *Cypridinodes*, the only one of these two sub-genera of which I have had material myself. A consequence of this is that several of the characters in this description are of generic and not of sub-generic value. *A diagnosis of the genus not worked out.*

Sub-genus Cypridinodes G. S. BRADY.

Cypridina (part.), G. S. BRADY, 1865 and 1897; G. W. MÜLLER, 1906 b and 1912. *Cypridinodes*, G. S. BRADY, 1902 a.

Description: — Shell: — The shape is somewhat oval with a well-developed posterior corner. The rostral incisur is rather deep and narrow (G. S. BRADY's figure of *C. favus*, 1902 a, pl. XXII, fig. 20, is in this respect, as in several others, quite incorrect, a fact that I verified when re-examining the type specimen). Near the inner margin of the incisur there are two medial bristles situated close to each other. Posteriorly the list runs in an unbroken line straight across the posterior part of the shell (I have not succeeded in finding the place where it passes into the list along the ventral margin of the shell). With very strong calcification. The forms hitherto known are comparatively large.

First antenna: — This is long, slender and has eight joints. The sensory bristle of the fifth joint has thirteen sensory filaments. Bristle b and c in the males are modified in the way described for the sub-genus *Doloria*. The distal bristles are not much longer in the males than in the females.

Second antenna: — The protopodite has a medial-distal bristle. Exopodite: The bristle of the second joint is powerfully developed. The natatory bristles on the third to the ninth joints are quite without spines. The second to the ninth joints have basal spines. Endopodite: This is similar in males and females and is comparatively well developed, elongated; the bristle of the end joint is relatively long.

Mandible: — Protopodite: The endite on the coxale is either simple distally or has only a faint indication of bifurcation; its spines are rather powerful, especially those

situated medio-distally, and are practically quite without any distinct arrangement in groups. Apart from the bristle of the endite there are no bristles at all on this joint. Basale: Of the ventral bristles one [illegible] bristle is very long and has numerous long secondary bristles arranged in irregular wreaths; distally it has short hairs; the others of these bristles are of moderate length or short and they all have short hairs or are almost bare. This joint has three bristles dorsally. E n d o p o d i t e: The first joint has four bristles ventrally. The end joint has seven bristles, of which the two middle ones are powerful, claw-shaped and of somewhat different lengths.

M a x i l l a: — P r o t o p o d i t e: The part of the procoxale and the coxale from which the three endites issue is developed as a somewhat heart-shaped appendage with an independent power of movement. The coxale has dorsally a single bristle. Proximally on the outside of the third endite there is a single bristle. On the boundary between the basale and the first endopodite joint there is only one bristle. No e p i p o d i a l a p p e n d a g e is developed. The e x o p o d i t e is very small comparatively and is displaced distally. The e n d o p o d i t e is long and narrow, the first joint is very much lengthened. (The proportion between the length of this joint and that of the second endopodite joint of the mandible is about 1 : 1, whereas in other species of this sub-family the proportion between the lengths of these two joints is about 2 : 3.

S i x t h l i m b: — The second e x o p o d i t e joint is very much elongated, becomes gradually narrower distally and has numerous bristles; its two posterior bristles form a sort of direct continuation of the joint and are strikingly larger than the other bristles on this joint.

S e v e n t h l i m b: — This is sometimes furnished with rather numerous, sometimes with quite a few, cleaning bristles. In the former case a large number of bristles and in the latter case a few bristles are concentrated ventero-distally but there is no such concentration dorso-distally. The other bristles are scattered irregularly along the distal part of the limb; with regard to the position of these bristles it is to be noted that in only a rather few cases more than one bristle is to be found on the same side of the same joint; sometimes (twice in the accompanying figure) two bristles are found close to each other on the same joint. The end comb consists of a moderate or a rather large number of rather strong teeth, some fairly long distal teeth, finely serrated on either side and rounded distally and some shorter and bare proximal teeth, cut off rather sharply distally. The part of the wall of the limb that is enclosed by the end comb is very much thickened and powerful; the part dorsally of the end comb is developed as a large and powerful chitinized jaw-like process, which moves freely and is furnished distally, on the side that is turned in the direction of the end comb, with a series of powerful teeth. On account of this the distal part of this limb gets an appearance very like the head of a fish. The „upper jaw“, the part of this limb on which the end comb is fixed like a set of teeth, can evidently be pressed a little downwards by the posterior longitudinal muscles of the limb; a fold of chitin, which goes from the „corner of the mouth“ ventero-proximally to an articulation knob situated somewhat below half the height of the „head“, shows the place where the bend takes place (cf. fig. 22 of *M. (C.) acuminata*). The compression of the „jaws“ takes place by means of an exceedingly powerful paired muscle, which rises up proximally somewhat proximally of the „lower jaw“ and is fixed distally to the wall of the limb, ventrally of the proximal teeth

in the end comb. (It seems certain, however, that the mechanism of the jaws is more complicated than is described here, but certain results with regard to this question seem impossible to attain with preserved material; the „lower jaw" can, as has been stated above, certainly move quite freely, and, in spite of this, it is not moved by special muscles fixed directly on it.)

F u r c a: — The lamellae are elongated. The number of claws is about five or six. There is no distinct division into main and secondary claws.

The u p p e r l i p has three fields of glands, one unpaired, directed forward and downward, forming a rather high process, cut off somewhat obliquely distally, and two paired fields, directed somewhat more ventrally and situated distally on two fang-like processes. Between the upper lip and the frontal organ there is an unpaired process.

The r o d - s h a p e d o r g a n is rather well developed but short.

The p a i r e d e y e s are well developed.

Remarks: — The description given above is based chiefly on the form described below and *M. (C.) asymmetrica* (G. W. MÜLLER), the only species of this sub-genus which are described in detail. *Basis of the [illegible]*

This sub-genus was established, as is seen above, by G. S. BRADY in his work of 1902 a. The following diagnosis is given, loc. cit. p. 187: „Like *Cypridina*, except as to the three pairs of maxillae. The first pair form a simple, elongated, triarticulate limb, which bears at its distal extremity several strongly pectinated claws and setae; to the basal joint is attached a small single-jointed trisetose palp. The second maxilla is in general built like that of *Philomedes* or *Cypridina*, but the principal masticating processes are armed with blunt nodular marginal teeth; third maxilla without the hatchet-shaped lobe of *Cypridina*, which is replaced by a digitiform prolongation, retaining, however, something of the hatchet-shape." *G. S. Brady's diagnosis.*

A comparison will show that there is no great agreement between this (to say the least of it) strange description and the new description I have given above of the same unit. This lack of agreement seems, however, at least to some extent, to be due to mistakes on the part of G. S. BRADY. Thus, for instance, this author has overlooked the peculiar freely moveable appendage of the maxilla from which the three endites issue. In the description of the second endopodite joint of the sixth limb there are also certainly some mistakes; the two very large posterior bristles, which are directed backwards and are closely covered with hairs, were presumably situated so very close to each other (possibly they were also broken off distally) in BRADY's preparation that they have produced an appearance something like what this author has described and reproduced (loc. cit. pl. XXII, fig. 28). Whether the main tooth of the first exopodite joint of the fifth limb has the equipment described by BRADY I must leave undecided; it does not seem impossible to me, however, that there is also a mistake with regard to this. This explanation of G. S. BRADY's peculiar statements has already been given by G. W. MÜLLER, 1906 b, p. 13. *[illegible]*

There scarcely seems to be any reason for seriously doubting that the species described below by me really belongs to this sub-genus. In spite of many mistakes in the description and reproduction of *M. (C.) favus* G. S. BRADY has not quite succeeded in concealing the type of this species. *[illegible]*

I have obtained confirmation of this identification by a re-examination of the typespecimen of this species of BRADY's (it is kept in the Zoological Museum at Copenhagen). Unfortunately only the shell is left of this important specimen; all the other organs are missing. As is shown by the description of the sub-genus given by me above, several mistakes were found in BRADY's description and figures. Contrary to what one would be inclined to expect from BRADY's statements, the type specimen exhibits a marked relationship to the species described by me below.

Number of species. In addition to *M. (C.) facus* there are certainly two other species belonging to this sub-genus, namely *Cypridina Bairdi* G. S. BRADY (1865, p. 387; pl. 62, fig. 7 and 1897, p. 88; pl. 16, figs. 22 and 23) and *Cypridina asymmetrica* G. W. MÜLLER (1906 b, p. 14; pl. 6, figs. 1–12). Of these two species, which are certainly very closely related to each other, the former is very little known; the latter, on the other hand, is one of the better known representatives of this sub-family. Both of them confirm the correctness of the new description of the sub-genus I have given above.

On account of the incompleteness of the descriptions it is impossible to decide whether any more of the species hitherto described are to be included in this group.

Function of the maxilla. With regard to the function of the maxilla in this sub-genus it may be pointed out here that the palp of this limb is certainly to be considered as an important organ of locomotion, while the endites — as is usual in this sub-family — are masticatory organs. This double function is rendered possible by the fact that the palp and the part from which the endites issue are capable of free motion independently of each other.

Distribution. All the forms of this sub-genus so far known come from the western part of the Pacific. (The locality of the type specimen is, however, unknown.)

Type species. Type species: *M. (C.) facus*, G. S. BRADY, 1902 a.

M. (Cypridinodes) acuminata n. sp.

Description: — Male: —

Shell: — Length, 5,5 mm. Length : height, about 1,5 : 1; this applies to the left valve, the right one is somewhat lower. Length : breadth, about 2 : 1. Seen from the side (fig. 1), it has its greatest height at about the middle and the posterior part of the shell is not, at least not perceptibly, larger than the anterior part. The dorsal and the ventral margins are arched rather boldly and almost uniformly and evenly, the ventral margin is, however, somewhat irregular, as it is somewhat pouting anteriorly; both join the anterior and the posterior margins without corners. The posterior part of the shell forms, at about half the height of the shell, a rectangular, pointed corner. The rostrum has anteriorly a strongly projecting but broadly rounded corner; its ventral corner is narrowly rounded and strongly marked because the ventral part of the anterior margin of the rostrum curves inwards rather decidedly. The narrow and rather deep rostral incisur is characterized by having its posterior margin defined from the ventral margin of the shell by a rather strongly marked corner. Seen from above

the shell has its greatest breadth at about the middle; its sides are evenly and uniformly curved; the anterior and the posterior ends are of about the same type, rather narrowly rounded. The surface of the shell has numerous very striking and rather large pores, but has practically no hairs at all. It is almost quite smooth, having small cavities only partly, at least anteriorly, and with finely reticulate sculpture, especially on the rostrum. Seen from inside (figs. 2 and 5): Medial bristles: On the rostrum there is a rather distinct row of fairly long bristles running obliquely upwards and forwards. Most of these bristles are of about the same type as is shown in fig. 4, in other words they are weakly bifurcated, the proximal part on one side is furnished with rather powerful secondary spines, the distal part having short, fine hairs. Some of these bristles are, however, more decidedly bifurcated, others are quite simple; some are equipped with more powerful spines, others are almost smooth. The ventral ones are not attached to a verruciform swelling. This row continues into a very dense row of bristles running a short distance along the dorsal edge of the rostral incisur, the bristles of which become more and more short and more and more powerfully equipped the more posteriorly they are fixed (cf. fig. 3 for the three posterior bristles in this row). Apart from this row of bristles there are on the rostrum a moderate number of what seem to be for the greater part simple and bare, short or rather long bristles, scattered both in front of and behind the row. The two bristles near the inner margin of the rostral incisur are rather short and powerful, and, like the posterior bristles in the row on the rostrum, furnished with strong spines, fig. 3. Above these, near the joining line, there is a single very small bristle; apart from these three there are no bristles inside the incisur. On the list behind the incisur there is a dense row of long bristles, of about the same type as is shown in fig. 4, and between these there are short, simple bristles; this row of bristles becomes more and more sparse posteriorly, the bristles becoming at the same time shorter and weaker, and even at a quarter of the way along the shell it practically ceases, although a few short, simple bristles may be observed on the list along the whole posterior part of the ventral margin of the shell. The posterior part of the list, inside of the posterior margin of the shell (perhaps it does not constitute an unbroken continuation of the list along the ventral margin of the shell; at any rate I did not succeed in observing any connection, cf. the diagnosis of the sub-genus) is broad and has a dense row of about 30—40 rather long spine-like formations, the exact shape and nature of which I have been unable to decide with certainty on account of the lack of material. On the part between the list and the margin of the shell there seem to be no bristles at all. On the rostrum the selvage is very narrow, extending only very slightly beyond the margin of the shell; along the ventral side of the shell, on the other hand, the selvage is very broad, and extends rather considerably beyond the margin of the shell, especially along the posterior margin of the rostral incisur — the incisur is quite filled by it — and along the anterior part of the ventral margin of the shell; it ends posteriorly at the posterior corner of the shell. It has close, fine and uniform cross-striation and is even or practically even at the edge, with only a faint indication of an extremely fine serration.

First antenna: — Third joint: The bristle on the anterior side is attached near the proximal boundary of the joint and is not quite as long as the anterior side of this joint; the postero-distal bristle is somewhat shorter. The anterior bristle of the fourth joint is not

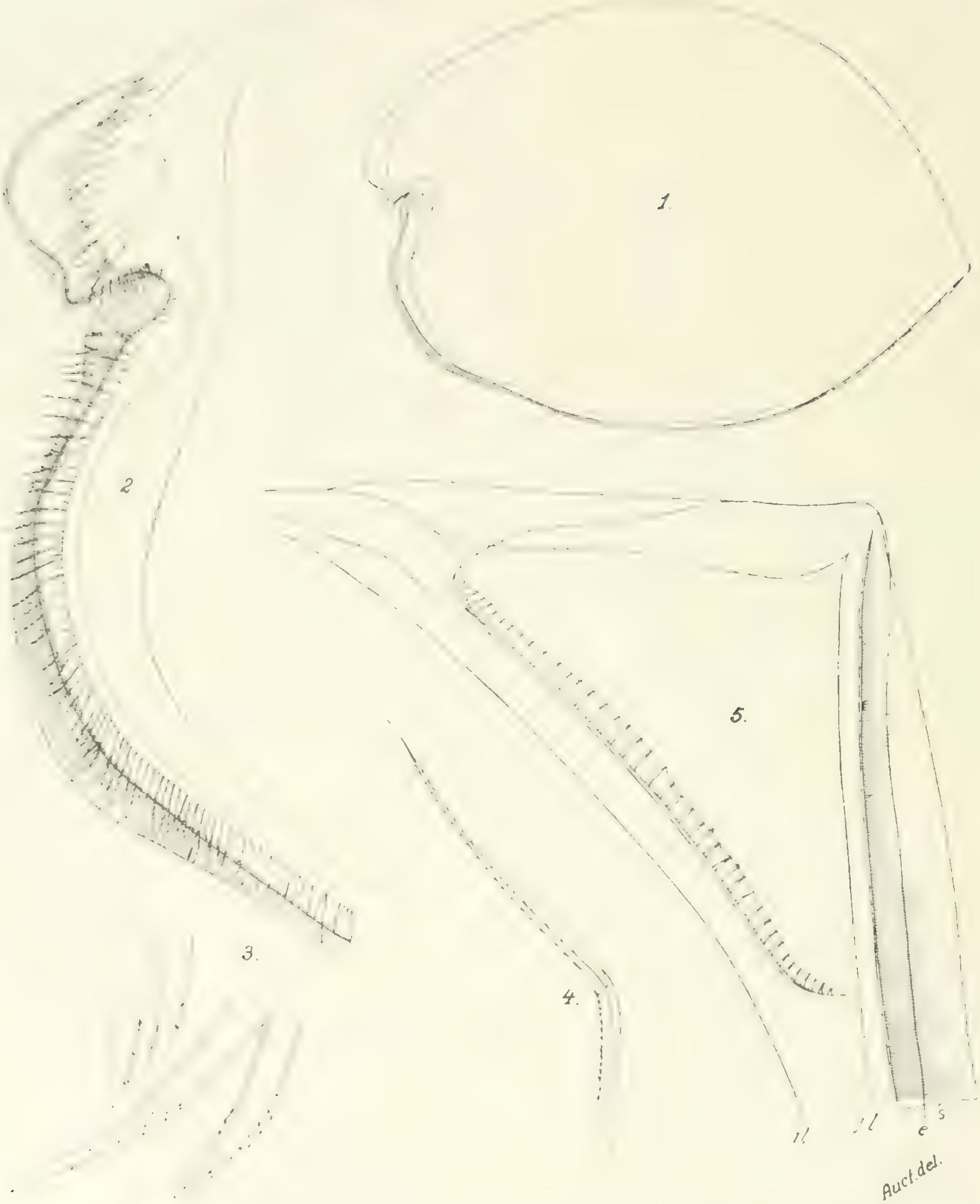

Fig. LXI. — *M. (Cypridinodes) acuminata* n. sp., ♂. — 1. Shell, seen from the side; 17,7 ×. 2. Anterior part of the right valve, seen from inside; 50 ×. 3. The two bristles near the inner edge of the rostral incisur and the three inner bristles in the row along the dorsal edge of the incisur; 500 ×. 4. One on the bristles on the list just behind the rostral incisur; 325 ×. 5. Posterior part of the right valve, seen from inside; 100 ×.

quite half the length of the following joint, the posterior bristle of this joint is still shorter. The bristle of the sixth joint is about as long as the anterior bristle of the fourth joint, the a-bristle of the seventh joint is about twice as long as this. All these bristles have short hairs or are almost bare; the hairs on the a-bristle of the seventh joint are very coarse, almost spine-like. The sensory bristle of the fifth joint is about as long as the anterior side of the six distal joints. Of its thirteen sensory filaments — all of them without secondary spines — the nine proximal ones are relatively long — about a third of the length of the bristle — and thick in comparison with the distal ones; the three following ones are considerably shorter — about a fifth of the length of the bristle — and narrower, and are attached considerably distally of the former ones; the remaining filament is very short and narrow and is attached near the point of the bristle. Of the distal bristles the c-, f- and g-bristles are subequal and slightly shorter than the anterior side of the seven distal joints, the b-bristle (measured to the point of its longest distal filament) is about a third shorter than these three. The b-bristle (see fig. 13) has five filaments. The proximal one of these (fig. 14) has no trace of any verruciform swelling distally of the sucker (such as is found in, for instance, *C. (Vargula) norvegica*, see above, fig. 15 of this species). Of the four other filaments on this bristle the three distal ones issue almost at the same point, rather close to the point of the bristle, the fourth is fixed somewhat proximally of the middle of the bristle. Two of the three distal filaments are bare and comparatively short and narrow, the third is long and rather powerful — extending far beyond the point of the bristle — like the one fixed somewhat proximally of the middle of the bristle. Of these long filaments the proximal one is furnished distally with from nine to eleven, the distal one with eight or nine, small suctorial organs, proximally of which one or two verruciform spines may be found. The c-bristles has ten filaments altogether. The proximal one of these is of the same type and strength as the corresponding one on the b-bristle. Seven filaments are of the same type as those of the f- and g-bristles (see below) but are bare or with only a few very short, fine secondary spines. Proximally of these seven filaments and between nos. 2 and 3 of them we find two long and rather powerful filaments (of the same type as the two last-mentioned filaments on the b-bristle), the proximal one having distally nine or ten, the distal one eight or nine small suctorial organs, proximally of which one or two short spines are found. The f-bristle has ten and the g-bristle eleven filaments of moderate length; most of these filaments (fig. 12) have two kinds of secondary spines, some, about two or three, strong and scale-shaped, the others short and fine; the distal filaments are either furnished only with secondary spines of the latter kind or else they are quite bare. The simple sensory bristles d and e are subequal and somewhat less than a third of the length of the last-mentioned bristles. Pilosity: The second joint has numerous transverse rows of short, fine hairs on both the anterior and the posterior sides. Apart from these this antenna is bare.

S e c o n d a n t e n n a: — P r o t o p o d i t e: Length, about 1,6—1,7 mm. The medial-distal bristle is short, being about as long as the shorter of the proximal bristles of the first endopodite joint; it is bare or almost so. The e x o p o d i t e has about the following proportion between the joints:

I : II : III : IV : V : VI : VII : VIII : IX = 31 : 6 : 3 : 3 : 2 : 2 : 2 : 2 : 1.

In other words the first joint is rather considerably longer than the total length of all the following joints, the second joint is about as long as the next two joints put together. The bristle of the second joint is somewhat longer than the eight distal joints and is furnished ventrally with about seventeen or eighteen strong secondary teeth, dorsally with a somewhat smaller number of weak and short ones. The proportion between the length of the longest natatory bristles and that of the whole exopodite is about three to two. The natatory bristles are furnished with broad, well developed natatory hairs. The end joint has four bristles of which the dorsal one is about as long as the total length of the six or seven distal joints and is furnished with well developed long natatory hairs. The second to the ninth joints have powerful and rather long conical basal spines, which decrease somewhat in length the more proximally they are situated, the one on the second joint being rather small, those on the fourth to the eighth joints are equal to or even exceed the length of the following joint. The e n d o p o d i t e is well developed and is of exactly the type reproduced for *C. (Vargula) norvegica*. The first joint has a group of four bristles proximally, one of which is somewhat more than twice the length of the three others and is somewhat shorter than the second joint; this joint has, in addition, ventrally at the middle a single bristle, which is somewhat longer than the longest proximal one. The second joint has ventero-distally a single bristle, which is not quite as long as the end joint. This bristle, like the two long ones on the first joint, has short hairs; the three short proximal ones are bare. The distal bristle of the end joint is not quite twice as long as the endopodite.

M a n d i b l e (fig. 6): — P r o t o p o d i t e: The endite on the coxale has very numerous spines; it is weakly bifurcated distally; the two distal points are somewhat, though only rather slightly, coarser than the other spines and like these they are smooth. Basale: This has seven bristles ventrally: two a-bristles, one b-bristle, two c-bristles and two d-bristles. Of these the a-, b- and c-bristles are very short; the longer of the d-bristles is about as long as the second endopodite joint, the other is about $^1/_4$—$^1/_3$ of this length. Of the three dorsal bristles the proximal one is attached a short distance in front of the middle of the joint and is somewhat shorter than the longest d-bristle; the longest distal bristle is about as long as or somewhat longer than the mentioned d-bristle, the other distal bristle is less than half the length of its neighbouring bristle. All three are of the same type as the long d-bristle, i. e. they have long secondary bristles arranged in irregular wreaths and have short hairs distally. The e x o p o d i t e is about as long as the dorsal side of the first endopodite joint; of its two bristles the proximal one is of about the same length and type as the shorter of the distal bristles situated dorsally on the second protopodite joint; the distal one, on the other hand, is very short, extending only slightly beyond the point of the exopodite, and has short, stiff hairs situated very close together distally. E n d o p o d i t e: Of the four ventral bristles on the first joint the two longest are of about the same type as the long bristles on the second protopodite joint, i. e. they have long secondary bristles arranged in irregular wreaths; the two others have short hairs. Second joint: On the anterior side there are a great number of bristles of different types. Some of these, about eighteen, are more or less long; among these there are some which have long, stiff secondary bristles arranged in irregular wreaths, distally of which there are close (as in the specimen shown in fig. 7) or

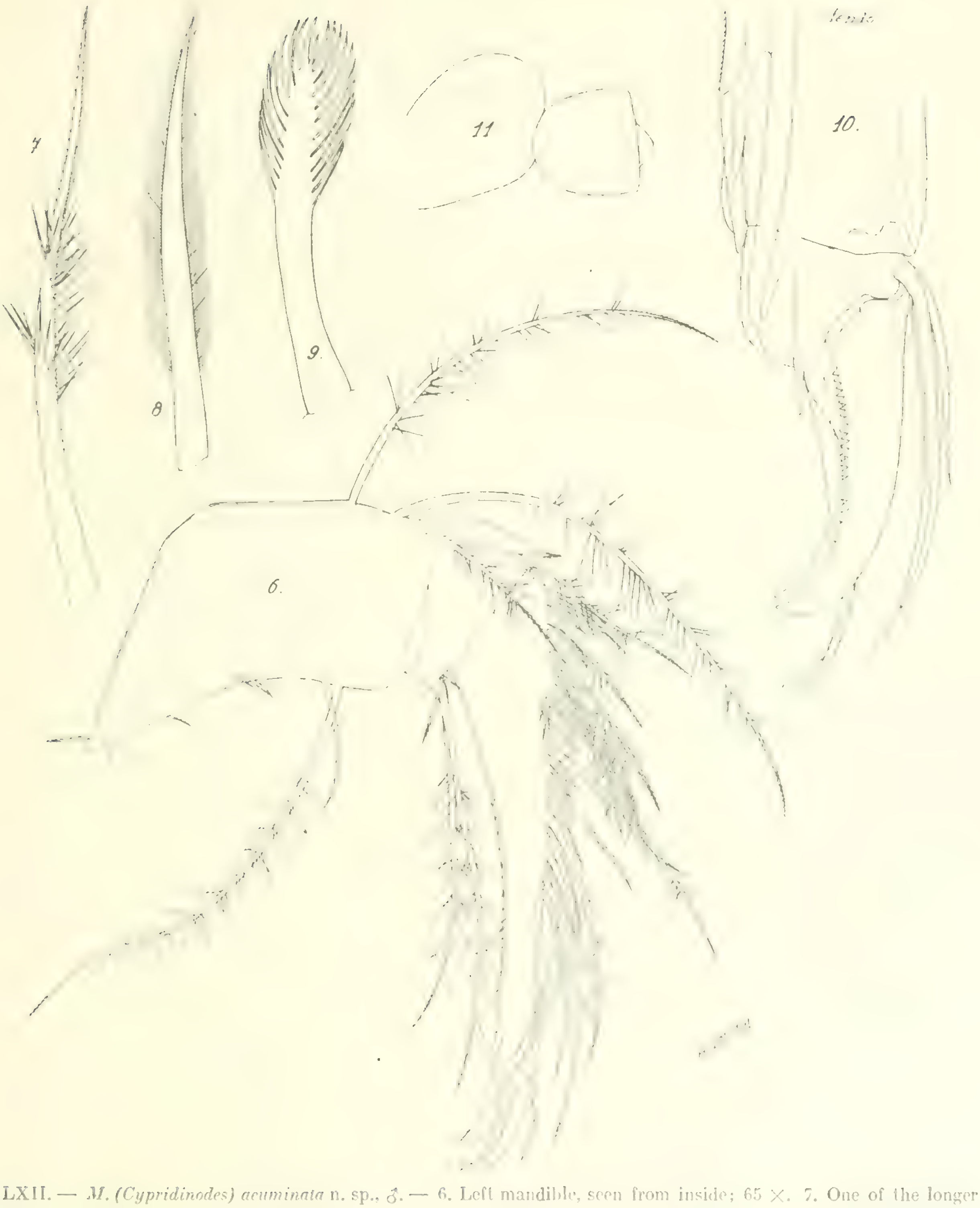

Fig. LXII. — *M. (Cypridinodes) acuminata* n. sp., ♂. — 6. Left mandible, seen from inside; 65 ×. 7. One of the longer bristles on the anterior side of the second endopodite joint of the mandible; 265 ×. 8 and 9. Two kinds of cleaning bristles on the second endopodite joint of the mandible; 570 ×. 10. The distal part of the right mandible, seen from outside; 265 ×. 11. Median eye and rod-shaped organ; 100 ×.

sparse short, fine hairs; others, especially those situated more distally, have only short, fine hairs or are almost bare. In addition there are numerous short cleaning bristles, all of about the same length, of two types, 22—25 of them with an extremely fine and dense double pectination (fig. 8; drawn as smooth in fig. 6), and a smaller number, about six or seven, with very powerful double distal pectination (fig. 9; the spines are shown in fig. 6). On the posterior edge this joint has, in addition, somewhat distally of the middle, two bristles, both of the same type, rather short, bare and spine-like, one of them situated somewhat distally of the other. Near the posterior distal boundary of the joint there are also two smooth, straight, spine-like bristles (fig. 10), situated at the side of each other; the lateral one of these is about as strong as the two last-mentioned bristles, but somewhat shorter than these, the medial one is considerably stronger and is about twice as long as the lateral one. The small end joint (fig. 10) is, especially posteriorly, very strongly chitinized. Of its bristles the two middle ones, the main claws, are extremely powerful, but short, being only about a fifth of the length of the second endopodite joint, and very strongly serrated along the proximal two-thirds of their length; (for practical reasons this serration is only drawn on one of these claws in the adjoining figure); of these two claws the lateral one is rather considerably shorter than the medial one. The two anterior ones, somewhat different in length from each other, are rather considerably shorter than the middle claws, weak and quite bare. Of the three posterior bristles, all bare, two are somewhat weaker than the two anterior ones, one of them being about as long as the longest, the other as long as the shortest, of the main claws; the third one of these bristles is very short. Pilosity: The first endopodite joint has short hairs dorso-distally, the second endopodite joint has posteriorly groups of short, fine hairs placed transversally.

M a x i l l a (fig. 15): — P r o t o p o d i t e (fig. 16): First endite: The bristles on the only specimen of this species I have had the opportunity of examining were defective; ten strong, subequal bristles of moderate length were observed. All of them were furnished with rather numerous long, stiff secondary bristles; on the two (originally there were presumably three) inner ones the secondary bristles continued right to the point of the bristles, on the others they stopped a short distance from it. Of the latter three were trifurcated distally and five had a simple strong point. Of the latter five one was smooth distally, the others were furnished with powerful distal secondary teeth. The second endite has seven rather powerful, subequal, moderately long bristles. All of them, except the one next to the outermost one, seem to be furnished at the middle with long, stiff secondary bristles; the four outer ones are pectinated distally, the three inner ones are smooth distally. The third endite has five moderately powerful distal bristles, of which the outer one is unusually long, about twice as long as the next outer one; the rest are moderately long, the inner one being somewhat shorter than the others. The inner bristle has short hairs; the outer one has, along a large part of its length, rather numerous, long and comparatively flexible secondary bristles and is extremely finely pectinated distally. The three remaining ones of these bristles have a moderate number of long, stiff secondary bristles at the middle, and are pectinated distally, the pectination on the inner one of them is, however, very weak. The proximal bristle on the outside of this endite is about half the length of the outside of the process and has short hairs. The dorsal bristle of the coxale is attached at about

Fig. LXIII. — *M. (Cypridinodes) acuminata* n. sp. ♂. — 12. A part of the c-bristle of the first antenna with the fifth filament; 480 ×. 13. The b-bristle on the first antenna; 105 ×. 14. The proximal filament on the last-mentioned bristle, 400 ×. 15. Maxilla; 62 ×. 16. The endites of the maxilla, 96 ×. 17. Distal part of the left maxilla, seen from inside; 165 ×.

the middle of the joint and has short hairs; it is about as long as the next to the outermost of the distal bristles on the third endite. The bristle on the boundary between the basale and the first endopodite joint is rather short, about as long as the proximal bristle on the outside of the third endite, and has short hairs. The exopodite is very small, almost verruciform, and is displaced distally almost to the middle of the long first endopodite joint. Of its three bristles the two distal ones are subequal and about half the length of the first endopodite joint; the proximal one is only about a quarter of the length of the distal ones. One of the distal ones is sparsely furnished with long hairs, the other is bare; the short proximal one has short hairs. Endopodite: The first joint has numerous transversal creases on its outside; one of these creases, somewhat distally of the exopodite, seems to extend across the joint; it can, however, scarcely be considered as an indication of a further division of this joint. The postero-distal part of this joint is not strongly chitinized nor developed as a cutting edge. Distally this joint has (fig. 17) two bristles on the anterior edge (denoted by x in the figure), one rather long and powerful, somewhat bent into the shape of a claw distally and having there a thick cushion of fine, soft hairs, the other considerably weaker and only about half the length of the former one and furnished at the middle with a few long, stiff secondary bristles. On the posterior edge there are three bristles distally (denoted by y in the figure). Two of these are of about the same length and strength as the longer of the two on the anterior edge and are very strongly pectinated distally, the third is weak, bare and only a little more than half the length of the two former ones. The end joint (fig. 17) has thirteen bristles: Four a-bristles, of which the next to the posterior one is of about the same type and size as the two powerful posterior distal bristles of the first endopodite joint, but with a still better developed pectination, the three others are somewhat shorter, rather weak, and bare. There seems to be no doubt that the other nine bristles on this joint are to be homologized with the groups of b-, c- and d-bristles on the end joint of other forms of this sub-family which are described in this work; this homologization is made very difficult, however, by the fact that the bristles are situated very close together and are somewhat displaced. The attempt at homologization, the result of which is seen in the accompanying figure 17, cannot be taken as quite certain, although there is a rather great probability that it is correct. If this homologization is used, these bristles are developed as follows: Three b-bristles, two of which are of the same type as the longest a-bristle, one almost as long as this bristle, the other somewhat shorter; the remaining b-bristle is only about a third or a half of the length of the shorter of the two former b-bristles, rather weak and weakly pectinated. Three c-bristles, the two posterior of which are subequal and also of the same type as the longest a-bristle, but not quite half the length of this bristle; the third, the anterior one, is very short, almost reduced and only weakly pectinated. Three d-bristles, subequal and of about the same type and length as the shorter of the two long b-bristles. Pilosity: The inside of the first endite has some fine hairs, the outside of the third endite has very close, fine hairs. The palp and the exopodite, on the other hand, are smooth.

Fifth limb: — Protopodite: The first endite has eight powerful bristles of moderate length. The proportion between these bristles is about what is shown in fig. 19 of *C. (Vargula) norvegica*, but bristles nos. 3 and 5, counting from the anterior side of the limb,

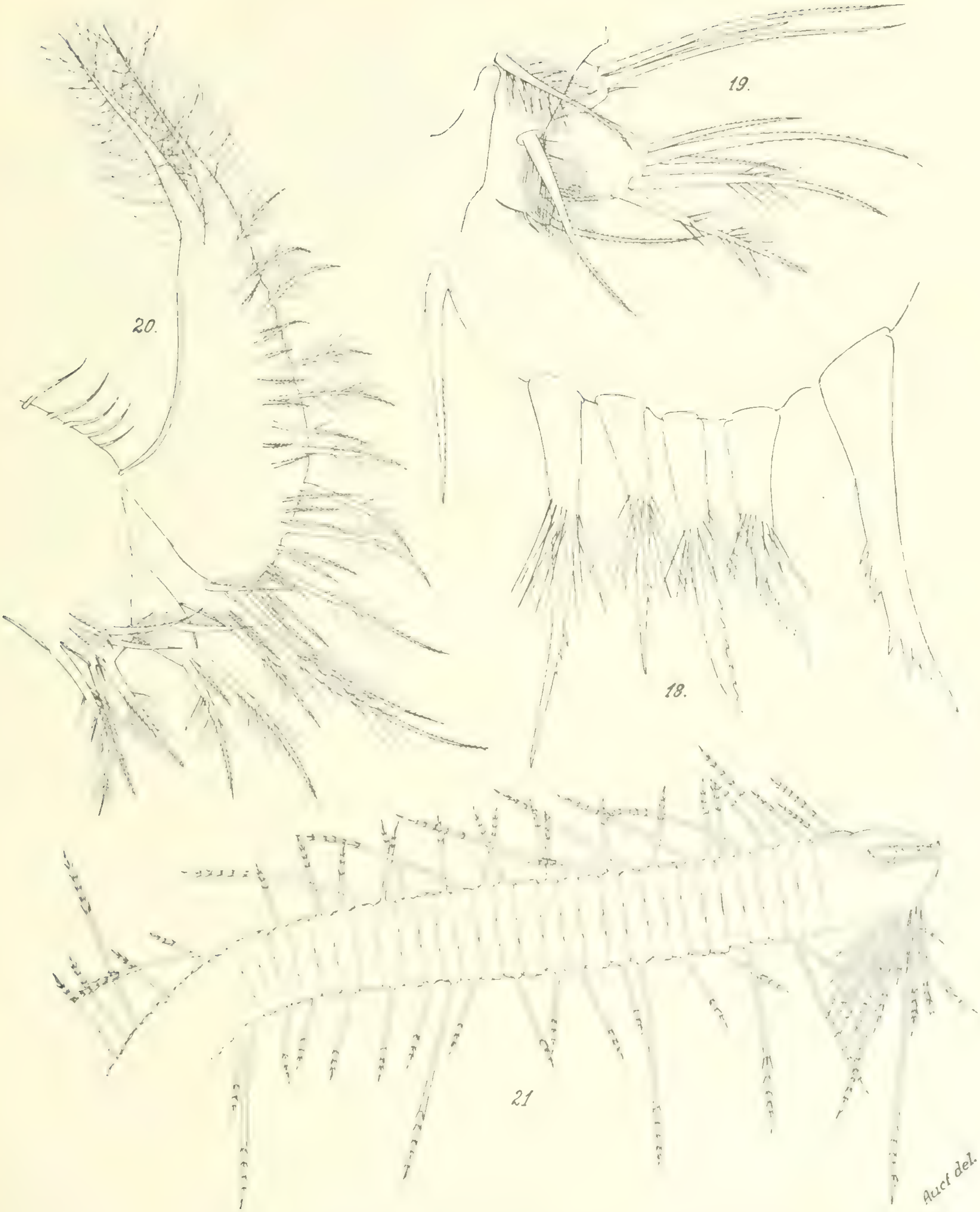

Fig. LXIV. — *M. (Cypridinodes) acuminata* n. sp., ♂. — 18. Second endite of the protopodite of the fifth limb; 352 ×. 19. Distal part of the exopodite of the right fifth limb, seen from in front; 105 ×. 20. Right sixth limb, seen from inside; 74 ×. 21. Seventh limb; 96 ×.

are relatively somewhat longer than in this figure. These two bristles have at the middle a few wreaths of long, powerful secondary bristles and are bare distally; the other bristles are furnished distally with similar secondary bristles, here too arranged more or less distinctly in wreaths. Second endite (fig. 18): The five inner bristles are moderately long, the middle ones being somewhat shorter than the outer ones, and powerful, the posterior one being somewhat more powerful than the rest. On the specimen that was investigated by me all these bristles, except the posterior one, were furnished at the middle with one or a few wreaths of long, stiff secondary bristles; the posterior bristle has no such wreath at all or only a reduced one, represented by a few short secondary bristles (see the drawing). Bristles nos. 1 and 2, counting from the front, were almost bare distally, only furnished with a few rather weak spines; no. 3 was sharply serrated distally; no. 4 was strongly pectinated; no. 5 was furnished near the point with rather few very powerful secondary teeth, proximally of which there were some weaker ones. The bristle on the anterior side of this process was moderately long and had short hairs. The seven bristles of the third endite are powerful and moderately long; the proportion between them is about the same as is shown in fig. 21 of *C. (Vargula) norvegica*. Bristles nos. 1, 3, 6 and 7, counting from the anterior side of the limb, are furnished at the middle with a wreath of long, stiff secondary bristles, the other bristles have no such secondary bristles. Bristle no. 1 is weakly pectinated distally; bristles nos. 2 and 4 are strongly pectinated distally; bristles nos. 3 and 5 are sharply serrated distally; bristles nos. 6 and 7 are very strongly pectinated distally. The distal spine of the protopodite is of moderate size, fig. 19. The e p i p o d i a l p l a t e has 71 to 73 bristles, all with long hairs almost right to their points. The e x o p o d i t e has four joints. First joint: The main tooth is composed of seven constituent teeth, which have about the same equipment as is shown in fig. 22 of *C. (Vargula) norvegica*. On the posterior side of this joint close to the main tooth there is a single bristle of about the same length and type as this bristle in the figure mentioned of *C. (Vargula) norvegica*. On the anterior side of this joint there are four bristles, which have about the same position and types as in the above-mentioned species; the third, counting from the inside, is, however, somewhat shorter relatively and has short hairs or is almost bare; the two inner ones are perhaps somewhat more powerful. The second joint has three a-bristles, ten b-bristles, one c-bristle and one d-bristle. The a- and b-bristles are somewhat more powerful than the corresponding bristles in *C. (Vargula) norvegica* (cf. fig. 22 of this species). The c- and d-bristles (fig. 19) are about as long and strong as in the species mentioned and of about the same type as each other, having close long and soft hairs at the middle and short hairs distally. The third joint is very small (fig. 19), its outer lobe even almost completely reduced. The inner lobe has four bristles distally; these are rather weak, have short hairs or are almost bare; two of them are moderately long, subequal; one is a little more than half as long as these, the fourth, the outer one, is quite short. Postero-proximally this lobe has, in addition, a bristle of about the same length as the shortest of the distal ones. The outer lobe has two bristles, one of moderate length and with short hairs and one, the outer one, very short, almost reduced, naked or almost naked. The end joint is moderately large and somewhat rounded; it has five moderately long bristles distally, of somewhat different lengths. They either have only short hairs or one or a few of them have, in addition, a moderate

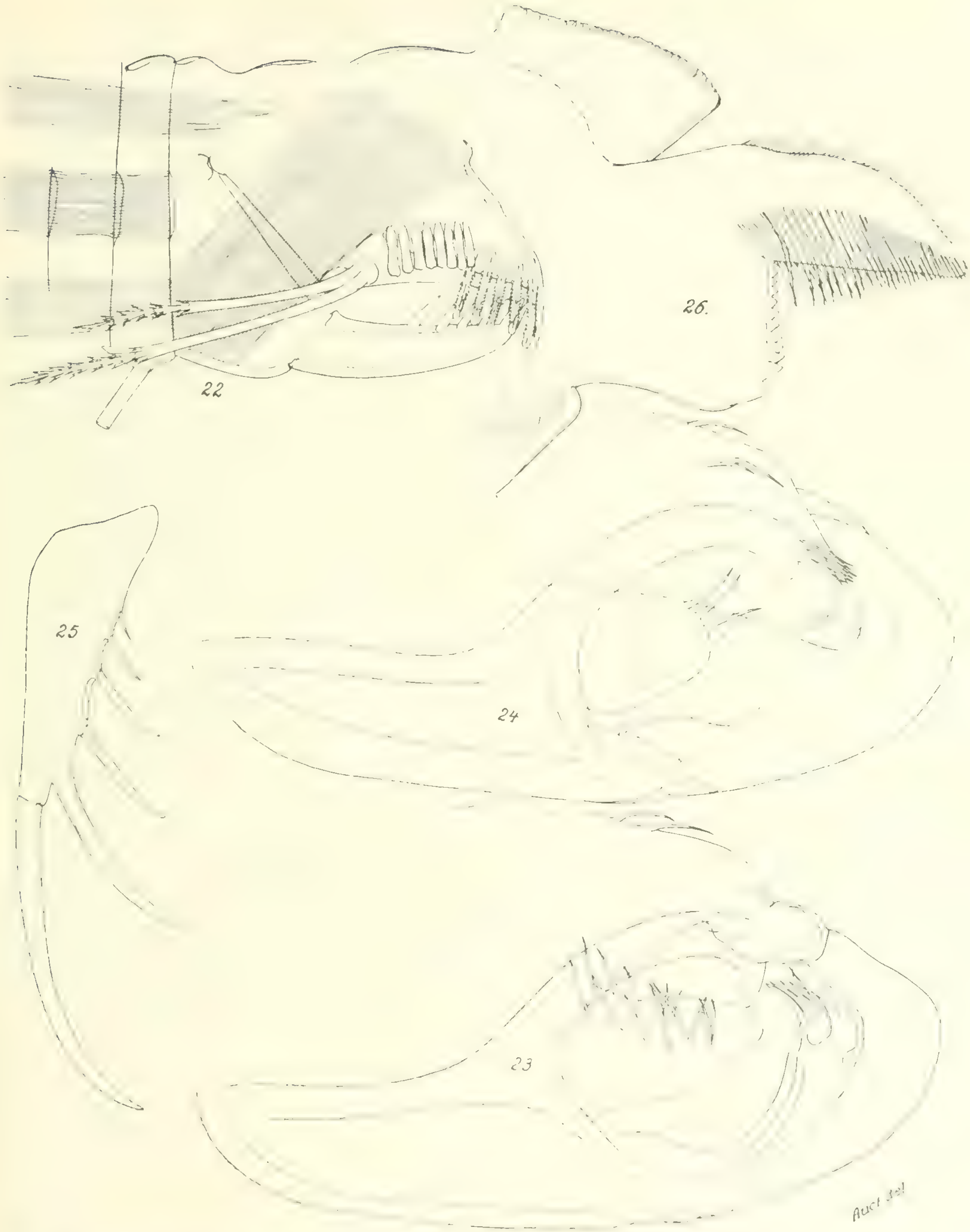

Fig. LXV. — *M. (Cypridinodes) acuminata* n. sp., ♂. — 22. Distal part of the seventh limb; 312 ×. 23. Right penis, seen from inside; 160 ×. 24. Left penis seen from outside; 160 × (Both penes drawn as if they were semi-transparent). 25. Furca (the secondary teeth of the claws are not drawn); 50 ×. 26. Upper lip, 96 ×.

number of long stiff secondary bristles at the middle. Pilosity: The outer lobe of the third exopodite joint and the end joint have at parts soft hairs.

Sixth limb (fig. 20): — Protopodite: The first endite has one rather long and powerful distal bristle, furnished with some wreaths of long, stiff secondary bristles and, in addition, with two short, plumous medial bristles. The second endite has three distal bristles; two of these are rather long and powerful and furnished at the middle with long, stiff secondary bristles, the dorsal one with short hairs distally, the ventral one rather strongly pectinated distally; the third is very short and bare or almost so. This endite has, in addition, two moderately long, plumous, medial bristles. The third endite has three distal bristles, two of which are rather long and powerful, with long, stiff secondary bristles at the middle and short hairs distally, the third is rather short and has short hairs; in addition this endite has a moderately long medial bristle, which is plumous at the middle. The epipodial appendage of the protopodite is represented by five rather short bristles, which are bare or almost bare. Exopodite: The endite of the first joint has the same equipment of bristles as the preceding endite; the ventral distal bristle, is, however, somewhat longer. The second exopodite joint has 32 bristles ventrally (the same number on both the right and the left limbs of the only specimen that was investigated); a number of these bristles are displaced rather far from the ventral edge up on the inside of the joint; there is no pronounced gap between the posterior bristles and the others. The two posterior bristles, as is pointed out in the diagnosis of the subgenus, are very large, directed backwards and furnished with long, soft hairs situated close together along their whole length. The other bristles are of different lengths, some rather long, some short, and of different types, some with long, stiff secondary bristles at the middle and short hairs distally, some with only short hairs; the long secondary bristles are only weakly arranged in wreaths; the short-haired bristles are usually the shortest. Pilosity: On the inside the limb has close, short, fine hairs; the second exopodite joint has latero-ventrally only groups of extremely short and fine hairs, but distally these hairs become somewhat longer.

Seventh limb (figs. 21 and 22): — This is very long, being almost as long as the shell. Cleaning bristles: Concentrated ventero-distally there are from 17 to 20 bristles varying somewhat in length; a few of the distal ones are moderately long or rather short; then there are a few rather long ones; the rest are moderately long or short; these bristles are furnished with from one to seven bells. On one side of the limb, proximally of and near the end comb, there are two moderately long bristles situated close to each other and furnished with five or six bells. In addition there are 15—19 ventral and thirty dorsal bristles scattered irregularly; these vary somewhat in length; some are rather short, usually furnished with three (in exceptional cases with only one or two) bells, some rather longer, usually with five (in exceptional cases four) bells. The bells are cut off transversally distally; the tongue of the distal bell is cut off very obliquely (of about the same type as that shown in figs. 27 and 28 of *C. (Macrocypridina) castanea*). Proximally of the bells the cleaning bristles are smooth. The end comb consists of eleven or twelve distal teeth and on each side of these eight proximal teeth. Round the distal half of the „lower jaw" at about equal distances from each other there are twelve simple, conical, pointed, bare and rather long and strong teeth.

Penis: — This is constructed according to the type that is characteristic for this sub-family. For details see the accompanying figures 23 and 24.

Furca (fig. 25): — This has six claws, the five posterior ones decreasing fairly uniformly and strongly in length and strength the more proximally they are situated. All the claws are well defined from the lamella except no. 2, which is entirely united to this. Proximally of the claws the furca is smooth.

Upper lip (fig. 26): — The unpaired upper glandular field is rather large and has numerous pegs of about equal size (= the mouths of the glands). The two paired ventral ones are moderately large. The fang-like processes on which the latter are situated issue dorsally from two rather large, wing-like processes, which are cut transversally off distally and there (ventrally of the fang-like processes) coarsely serrated, having about twelve or thirteen teeth. (It is to be observed that no glands have their mouths on these teeth.) The outside of the fang-like processes has a dense longitudinal row of bristles at about the middle. These bristles hang down like drapery; the proximal ones of them are about as long as the height of the processes proximally, rather broad proximally, narrowing distally and most frequently split at this part; the others decrease in length and breadth the more distally they are situated on the processes. Ventrally the fang-like processes are furnished thickly with fine more or less short hairs and dorsally they have groups of short, stiff hairs as well. The upper lip has groups of short, stiff hairs proximo-ventrally as well. The protuberance dorsally of the upper lip is small.

The rod-shaped organ (fig. 11) is very short and thick, somewhat drawn in distally, so as to seem sharply truncated with a small projecting distal knob, the point of the organ.

The lateral eyes are very large.

The back of the body has strong transverse folds.

No female is known.

Differences from other species.

Remarks: — Even with regard to the shell this species is distinguished so markedly from the other species of this sub-genus that there is no danger of any confusion. In the case of none of the species *M. (C.) farus*, *M. (C.) Bairdi* and *M. (C.) asymmetrica* is there information of any shell longer than 3 mm., while the species described above is no less than 5,5 mm. long. The shape and sculpture of the shells are also very different.

Relationship of the species.

The relationship between these species is impossible to decide because of the incompleteness of preceding descriptions.

Habitat: — Australia:

Cape Jaubert (type locality); depth: 25 m.; 13. VII. 1911: one mature male (coll. E. MJÖBERG).

Sub-Family Philomedinae.

Sub-Fam. *Philomedinae* (part.), G. W. MÜLLER, 1912, p. 24.

Diagnosis: — Cf. G. W. MÜLLER, loc. cit.

[illegible] worked out.

Remarks: — On account of the comparatively small number of species of this sub-family that I have had an opportunity of investigating closely, it has not seemed convenient to me to give in this connection a more detailed description of the sub-family than the one quoted above, worked out by G. W. MÜLLER. Such a description would, in any case, be very uncertain because of the uncertainty and incompleteness of the diagnoses and descriptions of the forms hitherto given.

[illegible] description of the genus Philomedes. Number of genera.

A natural consequence of this is that several of the characters that in the present treatise are included in the description of the genus *Philomedes* are certain to be characters of the sub-family.

Five genera of this sub-family have so far been established viz.:

Philomedes, W. LILLJEBORG, 1853,
Pleoschisma, G. S. BRADY, 1890,
Pseudophilomedes, G. W. MÜLLER, 1894,
Tetragonodon, G. S. BRADY and A. M. NORMAN, 1896.
Paramekodon, ,, ,, ,, ,, ,, ,, ,, ,,

In his synoptic work of 1912 G. W. MÜLLER approves of only two of these five genera, viz. *Philomedes* and *Pseudophilomedes*. The genera *Pleoschisma* and *Tetragonodon* are in this work included under the genus *Philomedes*; *Paramekodon* is identified with *Pseudophilomedes*.

Unfortunately the descriptions of the species that are included in the genera *Pleoschisma* and *Tetragonodon* are very incomplete and presumably partly incorrect. It seems to me rather probable, however, that this procedure of G. W. MÜLLER's is to be considered premature at least in one point. As far as I can see at least the species included under *Pleoschisma* represent so different a type that they must be dealt with as a special genus. With regard to *Tetragonodon* it does not seem impossible to me that it must be regarded as a special unit, perhaps as a sub-genus of the genus *Philomedes*. These questions can, however, only be decided after a renewed investigation of these forms. — In the identification of *Paramekodon* with *Pseudophilomedes* MÜLLER certainly is correct.

Reproduction of Pseudophilomedes, Pleoschisma and Tetragonodon.

Oecology of reproduction: — With regard to the phenomena connected with the reproduction nothing at all is known about the species described under the names of *Pseudophilomedes*, *Pleoschisma* and *Tetragonodon*.

Reproduction of Philomedes.

The reproductive oecology of the genus *Philomedes* (sensu meo) has some very interesting peculiarities to show.

In the following exposition of some of these phenomena in the last-mentioned genus attention will chiefly be paid to a single species, *Ph. (Ph.) globosa* (W. LILLJEBORG). This seemed convenient to me partly because of the great part this species has played in the investi-

gation of this problem, partly because this species was the only one of this genus of which there was ample material at my disposal.

History of Ph. (Ph.) globosa.

I shall first give a résumé of the history of the investigation of this species with a few remarks about other species.

The female was described in 1853, p. 171 by W. LILLJEBORG and was placed by this author in the previously known genus *Cypridina*. In the same treatise, p. 176, an additional new Cypridinid was described, which had been found at the same locality as the former one. On account of the far-reaching differences that this form showed from all other species of this group then known to this author, it was established as a representative of a new genus, *Philomedes.*

In 1865 G. O. SARS, pp. 109 and 110, gave *Cypridina globosa* as a representative of a new genus, *Bradycinetus*. At the same time this author gave some interesting oecological information about this species. On pp. 111 and 112 in the work mentioned we read as follows: „Jalmindelighed har jeg fundet Børsterne paa de nedre Antenner, saaledes som de ogsaa ere fremstillede paa LILLJEBORGS Figur, meget korte, aftagende i Laengde mod Spidsen samt ucilierede. Kun hos enkelte Individer, der forresten i et og alt stemme med de andre, finder man den maerkelige Afvigelse, at de til de 5 sidste Led faestede Børster ere saerdeles staerkt forlaengede og altsaa skikkede til Svømning. Herpaa blev jeg først ganske ved et Tilfaelde opmaerksom. Blandt en Del Exemplarer, jeg havde staaende i et Glas Søvand saa jeg nemlig til min Forbauselse, et Individ pludselig opgive den traege krybende Bevaegelse, som jeg ifølge de nedre Antenners Bygning havde anseet som den eneste mulige for denne Slaegt og med en eiendommelig rullende Bevaegelse gjøre en kort Udflugt op fra Bunden af Glasset. Ved Undersøgelsen af dette Exemplar befandtes som jeg havde ventet de nedre Antenner forsynede med lange fjaerede Svømmebørster. Paa Grund af denne Ulighed troede jeg, at Exemplaret muligens kunde vaere en Han, men fandt ikke dette bekraeftet ved den anatomiske Undersøgelse. Senere har jeg blandt mine Spiritusexemplarer fundet flere saadanne for Svømning skikkede Individer og har overbevist mig om, at de ligesaavel som de med korte Børster forsynede ere Hunner. Heller ikke er denne Ulighed afhaengig af Alderen, da jeg saavel har fundet unge som aeldre Individer paa denne Maade udrustede. Fuldkommen lignende har jeg ogsaa fundet Forholdet has følgende Art." (= *Philomedes (Ph.) Lilljeborgi*) „Hos enkelte Individer, som jeg, uagtet jeg ikke har kunnet opdage nogen tydelige Copulationsorganer, maa anse for Hanner, vise disse Organer endnu en maerkelig Eiendommelighed, idet den kortere Gren (Bigrenen) er betydelig større end hos Hunnerne og forsynet med et langagtigt membranøst med 2 korte Børster forsynet Endeled, der aldeles mangler hos Hunnerne."*

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* The following translation is (with a few corrections) reproduced from G. S. BRADY, 1868 b, p. 467: „I have mostly found the setae of the lower antennae, as represented in LILLJEBORG's figure, very short, decreasing in length towards the apex, and non-plumose. Only in a few specimens" (G. S. BRADY writes: but in one individual . . . .) „which in other respects agree with the rest, one finds a remarkable variation, the setae attached to the last five joints being much elongated, and adapted for swimming. My attention was first drawn to this as follows. Among several specimens which I had in a glass of sea-water, I saw, to my surprise, one individual suddenly abandon its slow, creeping movement, which, from the structure of the lower antennae, I had alone thought possible for this genus and, with a peculiar rolling movement, give a short bound upwards from the bottom of the glass. On examination of the animal, I found that the lower antennae were armed with long swimming-setae. On account of this peculiarity.

Philomedes (Ph.) longicornis is mentioned in the same treatise by G. O. SARS as being found, though rarely, both in the mud of the bottom and in the plankton.

In 1869 the same author put forward the notable supposition that *Bradycinetus globosus* and *Philomedes (Ph.) longicornis* were females and males of the same species, which he called *Ph. globosus*. Thus, according to the statement in this work, this species has two kinds of males, *Ph. (Ph.) longicornis* and the form that is distinguished from the females by a powerful development of the endopodite of the second antenna, and two kinds of females, those with short and those with long natatory bristles on the exopodite of the second antenna. This author observed the same conditions in a closely-related species, *Ph. (Ph.) Lilljeborgi.*

It is certainly true that for a short time *Bradycinetus globosus* and *Philomedes (Ph.) longicornis* were still looked upon as belonging to two separate genera, as, for instance, in G. S. BRADY's work of 1871, which is exceptionally inconsistent in dealing with this problem; the reasons in support of G. O. SARS's supposition were, however, so strong that this author's view that we are concerned with males and females of the same genus and even of the same species was very soon completely accepted.

In his large monograph on the Ostracods of the Gulf of Naples G. W. MÜLLER, at the same time as he affirms the union of the genera *Bradycinetus* and *Philomedes*, puts forward a new view with regard to the dimorphism that G. O. SARS had pointed out among males and females. On this MÜLLER writes, p. 187: „Die Fragen, die sich nach dem Gesagten an *Philomedes* knüpfen — Zusammengehörigkeit der Gattungen *Bradycinetus* und *Philomedes*, Existenz von zweierlei ♀ bei *B.* — beantworten sich an der Hand der Entwicklungsgeschichte, resp. mit Hülfe von Zuchtversuchen sehr einfach dahin, daß 1) *Bradycinetus* als ♀, oder als Jugendform zu *Philomedes* als ♂ gehört; daß 2) die Individuen mit kurzen Schwimmborsten lediglich Jugendstadien der ♂ oder ♀ mit langen Schwimmborsten sind.

Die Beobachtungen, auf welche ich diese Sätze gründe, sind kurz folgende. Es gelingt, aus typischen *Bradycinetus* die ♂ von *Philomedes* zu ziehen, oder umgekehrt: die ♂ zeigen bis zum Eintritt der Geschlechtsreife in der Schale, sowie im Bau der 1. Antenne und der Freßwerkzeuge durchaus den Charakter der geschlechtsreifen ♀. (In der Gestalt des Nebenastes der 2. Antenne und in der Pigmentierung des Auges bereiten die letzten Stadien des ♂ bereits die secundären Geschlechtsmerkmale vor, was SARS in der oben citierten Stelle veranlaßt, von ♂ von *Bradycinetus* zu sprechen.)

Für den zweiten Satz vom sogenannten Dimorphismus der ♀ will ich folgende Beobachtungen geltend machen. Nie ist es mir gelungen, bei einem Weibchen mit kurzen Schwimmborsten

I thought that the specimen might possibly be a male, but did not find this surmise borne out by anatomical examination. I have since found amongst my preserved specimens many individuals thus fitted for swimming and have convinced myself that they like those with the short setae are females.“ (BRADY's translation is not quite correct here. He writes: „. . . . and have convinced myself that those with the short setae are females“). „The peculiarity is not one of age merely, for I have found it in both young and old individuals. I have noticed it also in another species.“ (*Ph. (Ph.) Lilljeborgi*) „In a few specimens“ [BRADY writes: „In this single example (which though . . . etc.)“, an incorrect translation which destroys the whole meaning of SARS's exposition.]“ (which though I could not satisfactorily detect the copulative organs, I must take for males) the lower antennae show another marked peculiarity, the shorter branch being much larger than in the female, and having an elongated membranous terminal joint armed with two short setae, which is entirely wanting in the females.“

Eier oder ein entwickeltes Receptaculum seminis zu finden (auch SARS erwähnt nichts von Eiern); sämmtliche Jugendformen von *Philomedes*, vom 1. Stadium beginnend, haben kurze Schwimmborsten, sind unfähig zu schwimmen; verschiedenfach habe ich aus Thieren mit kurzen Schwimmborsten — mit langen Schwimmborsten gezogen. Was SARS zu der Annahme eines Dimorphismus geführt hat, ist wohl der geringe Größenunterschied zwischen den geschlechtsreifen Thieren und den letzten Jugendstadien und weiter der Umstand, daß man die Jugendstadien viel häufiger erhält als die geschlechtsreifen Thiere."

These statements of G. W. MÜLLER's are based on investigations carried out on the three species *Ph. (Ph.) interpuncta* (W. BAIRD), *Ph. (Ph.) aspera* G. W. MÜLLER and *Ph. (Ph.) levis* G. W. MÜLLER, all occurring in the Mediterranean.

Afterwards this writer investigated very carefully the species that formed the basis of G. O. SARS's statements, namely *Ph. (Ph.) globosa*. The exceedingly interesting results of this investigation were given in a small essay of only five pages, found in „Mittheilungen aus dem naturwissenschaftlichen Verein für Neu-Vorpommern und Rügen in Greifswald", 1898. In this essay we read as follows, pp. 42, 43: „Zu meiner großen Ueberraschung fand ich bei einem der ersten Thiere, das ich untersuchte, Eier im Brutraum und an der 2. Antenne kurze Borsten — also ein geschlechtsreifes Weibchen mit kurzen Schwimmborsten, daneben andere mit langen Schwimmborsten. Ich glaubte SARS Unrecht gethan zu haben, war einigermaßen begierig, die Beziehungen beider Formen zu einander kennen zu lernen, die ja sehr mannigfaltig sein konnten, vielleicht waren diese Weibchen mit kurzen Borsten Eier producirende Larven; hatte man es mit einem Fall von Pädogenesis zu thun, oder handelte es sich wirklich um einen Fall von Dimorphismus? An so viele Möglichkeiten ich auch nach der ersten flüchtigen Untersuchung gedacht hatte, die Lösung, die sich bei genauerer Untersuchung ergab, ist mir zunächst nicht in den Sinn gekommen. Diese zeigte, daß bei den fraglichen Weibchen die Borsten der zweiten Antenne nicht von Haus aus so kurz waren, daß sie vielmehr nachträglich abgebrochen oder abgebissen waren. Um eine zufällige Verletzung konnte es sich dabei unmöglich handeln; Bruch einzelner Borsten war übrigens selten; bei den fraglichen Thieren waren die Borsten stets in ganz bestimmter Entfernung von der Spitze des Außenastes und etwa in gleicher Höhe abgeschnitten. Da die große Mehrzahl der geschlechtsreifen Weibchen (vergleiche die unten gegebenen Zahlen) in dieser ganz typischen Art und Weise verletzt waren, scheint ein Zufall vollständig ausgeschlossen.

Von den Larven unterschieden sich die fraglichen Weibchen im Bau der zweiten Antenne dadurch, daß einmal die Schwimmborsten nicht spitz, sondern stumpf, gerade abgeschnitten endigten, daß ferner die Borsten der 4 letzten Glieder deutlich gefiedert, nicht wie bei den Larven ungefiedert waren."

G. W. MÜLLER subjected a material amounting to 197 specimens to a careful investigation. During this he discovered:

114 larvae with short natatory bristles

21 sexually mature males

15 „ „ females with long, unbroken natatory bristles

47 „ „ „ „ short, broken „ „

The sexually mature females with long, unbroken natatory bristles had no eggs at all in the brood chamber.

Of the sexually mature females with short, broken natatory bristles

32 had eggs in the brood chamber

15 had no „ „ „ „ „

On the basis of these facts this author makes the following statement, pp. 43, 44: „Ich kann da natürlich nur Vermuthungen geben, glaube aber, daß die folgende Hypothese einmal mit den Thatsachen wohl vereinbar, auch sonst einige Wahrscheinlichkeit für sich hat: Nach der letzten Häutung, mit der das Weibchen die langen, gefiederten Schwimmborsten erhält, tummelt es sich frei schwimmend im Wasser bis es ein Männchen trifft und begattet wird. Darauf begiebt sich das Thier dauernd auf den Grund, um in Sand und Schlamm grabend seine Nahrung zu suchen. Die Schwimmborsten haben ihren Dienst gethan, sie sind bei der unterirdischen, grabenden Lebensweise in ganzem Umfang nur hinderlich, — so werden sie zum größten Theil entfernt, vermuthlich mit Hülfe des ersten Thoracalbeines (sog. 2. Maxille) abgebissen (dafür spricht die Länge der Stummel). Nach dieser Auffassung wären die Schwimmborsten der Weibchen vergleichbar den Flügeln der Geschlechtsthiere der Ameisen und Termiten, welche bekanntlich ebenfalls nur zum Hochzeitsflug dienen, nach der Begattung abgeworfen werden."

He then adds: „Wie steht es nun eigentlich mit dem von SARS behaupteten Dimorphismus, hat er Larven oder verstümmelte Weibchen als solche mit kurzen Borsten angesprochen. Unzweifelhaft beides, denn daß ihm Larven vorgelegen haben, erhellt aus seiner Beschreibung der Borsten, die er als ungefiedert bezeichnet; andererseits müssen ihm auch verstümmelte Weibchen vorgelegen haben, da er sonst nicht die fraglichen Thiere mit aller Bestimmtheit als Weibchen hätte ansprechen können."

Finally this writer states in this treatise that among the six species of the genus *Philomedes* that he had had an opportunity of investigating *Ph. (Ph.) globosa* is the only one in which females with broken natatory bristles are found.

When about ten years later, however, he investigated the Ostracod material from the „Deutsche Südpolar-Expedition, 1901—3" he found the same oecological peculiarity in another species of this genus, *Ph. (Ph.) assimilis* G. S. BRADY, which occurs in the Antarctic. This find caused him to make the following statement, 1908, p. 89: „Überraschend ist die Tatsache, daß wir denselben Gewohnheiten bei zwei Arten begegnen, von denen die eine die Arktis, die andere die Antarktis bewohnt, daß in den zwischenliegenden Gebieten Formen mit ähnlichen Gewohnheiten fehlen, wenigstens kennen wir keine, was allerdings nicht viel beweist. Doch dürfte es sich hier nicht etwa um eine Konvergenzerscheinung handeln, vielmehr um ein Erbteil einer gemeinsamen Stammform. Ich betrachte *Philomedes brenda*," *(globosa)* „(die arktische Form) und *Ph. assimilis* als die nächsten Verwandten, besonders mit Rücksicht auf den Bau der Furca."

In his essay quoted above G. W. MÜLLER does not touch on the important question whether *Ph. (Ph.) globosa* had really been found swimming freely in the plankton. Perhaps this writer did not know of any statements with regard to this. — Statements in this direction, though only very few, were, however, to be found in the literature even before this author put forward his hypothesis quoted above. Thus G. O. SARS writes, 1865, in his work mentioned

above, p. 108: „et enkelt Exemplar" (of *Ph. (Ph.) longicornis*, consequently a male) „togtes ved Lofoten ganske naer Overfladen af Vandet".* — W. LILLJEBORG mentions, 1876, p. 4: „Några hanar hafva tagits i hafsytan vid 79° 56′ N. och 15° Ö., hvilket utvisar, att dessa med sina mera än honornas utbildade simorganer äro rörligare än de sednare, och sannolikt ofta simma upp till hafsytan, då deremot honorna hålla sig vid bottnen".** — Finally C. W. S. AURIVILLIUS in his work of 1896 states that this species (he does not say whether there were only males or both males and females) was taken in the plankton in Baffin's Bay during July.

By the investigations carried out by the „Conseil permanent international pour l'exploration de la mer" this species — like a few others of this genus as well — has been observed in the plankton on several occasions. C. APSTEIN, who in 1911 made an analysis of the plankton tables founded on these investigations, arrived at the following results about *Ph. (Ph.) globosa*, pp. 168 and 169: „Es ist zu erwarten, daß die Art nur während der Zeit der Fortpflanzung mit Planktonnetzen erhalten wird, in der übrigen Zeit, da sie auf dem Boden lebt, gar nicht, oder höchstens dicht über dem Boden.

So fand sich dieser Ostracode 1907 II.† Sc.†† 23†† nur in 138 m (Boden), 1903 VIII. D. N. 9 nur in 450—300 m, vermutlich näher an 450 als 300 m. Sonst fand die Art sich nur noch im Mai, in Planktonfängen, mit Ausnahme des östlichen Skageraks:

Im	Februar	1904	S.	Sk.	1:	0	m	— +	Tiefe	des	Bodens	200	m
..	..	..	..	..	2:	50—0	„	— r	..	..	..	122	..
..	..	..	..	..	2:	0	..	— o					
..	..	..	..	..	5:	30 0	..	— rr	..	..	..	75	..
..	..	..	..	..	5:	0	..	— o					
..	März	1906	„	..	7:	0	..	— rr	..	..	..	670	..
..	..	..	..	..	16:	0	..	— r	..	..	..	115	..

Abgesehen vom östlichen Skagerak und den beiden oben angeführten Fällen fand sich *Philomedes Brenda „(globosa)"* nur im Mai im Plankton von den Faeröer bis in das südliche Kattegat. Die Fänge im Ocean im April—Juni ergaben Exemplare der Art nur in Oberflächenfängen. In der Norwegischen Rinne und dem westlichen Skagerak fand die Art sich in allen Maifängen an der Oberfläche, einmal außerdem in 430—100 m (D. N. 9), also wohl dicht über dem Boden oder während des Aufsteigens zur Oberfläche resp. des Niedersinkens zum Boden. Im östlichen Skagerak war die Art fast stets in oberflächlichen Schichten zu treffen, im Kattegat mit seinen meist geringen Tiefen hauptsächlich an der Oberfläche, naturgemäß auch in dazwischen liegenden Wasserschichten.

Philomedes Brenda „(globosa)" wird also von April bis Juni an die Oberfläche des Meeres steigen, um sich zu begatten. Eine Ausnahme von dieser Regel finden wir im östlichen Kattegat, ob es sich dort im Februar 1904 auch um reife Tiere handelt, müßte erst festgestellt werden; von

* Translation: „a single specimen" (a male) „was caught at Lofoten rather near the surface of the water".

** Translation: „Some males were taken at the surface of the sea at 79° 56′ N. and 15° E., which shows that these, with their natatory organs more developed than the females, are more capable of motion than the latter and probably often swim up to the surface of the sea, while the females, on the other hand, keep to the bottom."

† Number of the month.

†† Name and number of the station, see Conseil perm. expl. mer. Bull. Résultats 1902—1903, Copenhagen 1903.

vornherein ist es wohl nicht anzunehmen, daß die Art hier früher reif sein sollte als anderswo, für März 1906 gilt dasselbe, falls nicht schon im März das Aufsteigen beginnen sollte. Gegen das Aufsteigen zum Zwecke der Begattung im Februar sprechen die übrigen Untersuchungen. Es könnte sich auch um das Aufsteigen unreifer Exemplare infolge besonderer hydrographischer Verhältnisse handeln; solche finde ich aber für Februar 1904 nicht; es könnte sich ja auch nur um Aenderungen des Wassers dicht über dem Boden handeln, da die Tiere auf dem Boden leben." . . . . . .

In the plankton tables of the „C o n s e i l p e r m a n e n t etc." there is no information about the sex of the specimens captured and consequently there is not in C. APSTEIN's either any information as to whether females of this species are to be found in the plankton or whether his statements, like those of SARS, LILLJEBORG and AURIVILLIUS mentioned above, are to be referred to finds of males only. C. APSTEIN himself had evidently no opportunity of investigating the material on which the plankton tables in question were based.

The collection of O s t r a c o d s in the S w e d i s h S t a t e M u s e u m comprises partly very abundant material of *Philomedes (Ph.) globosa* (about a hundred samples amounting to many thousand specimens; most of these specimens had been captured at the bottom, but also plankton samples occur), partly representatives of four other species of this genus, viz. the Scandinavian *Ph. (Ph.) Lilljeborgi* and the Antarctic *Ph. (Ph.) rotunda*, *Ph. (Ph.) Eugeniae* and *Ph. (Scleroconcha) Appellöfi*. This material has been subjected to a very careful investigation by me.

My investigations of *Philomedes (Ph.) globosa* gave the following results:

To begin with some bottom samples of this species from different parts of the year were examined. The results of these investigations are shown in the following table:

	Mature ♀♀ without eggs in the brood chamber. The swimming bristles of the second antenna broken. Old.	Mature ♀♀ with eggs in the brood chamber. The swimming bristles of the second antenna broken.	Mature ♀♀ without eggs in the brood chamber. The swimming bristles of the second antenna broken. Young.	Mature ♀♀ without eggs in the brood chamber. The swimming bristles of the second antenna unbroken.	Mature ♂♂	First larval stage.	Second larval stage.	Third larval stage.	Fourth larval stage.	Fifth larval stage.
January .		9		2	1	4	7	1		
February .	1	4	1							
March . .		5		2	2	6	4			
„ . .	3	7		5	3	9	5			
„ . .	5	9	2	4	1	4	2			
8th April		12	7	5		18	14	1		
16th „		15	3	3	1	24	15			
22nd May	4	15	6	2		10	8	2		
5th June	3	10	8	5		13	8			
8th July	5	8	2			10	6			
August .		9	12	2	7	15	5	3	2	
„ .	2	20	4	1	2	18	7			
7th Sept.		3	2			13	3		3	
31th „	1	10	3		2	5	10	21	8	3

The samples on which this table is based were taken at Spitzbergen and Greenland, thus from two places with rather similar external physical conditions.

It must be pointed out here that the figures in this table state only how many specimens were closely investigated by me. They must, on the other hand, by no means be considered as statements of the approximative proportions between the categories of the table. The samples in question were certainly rather incomplete; they had — if I am not mistaken — not been collected for quantitative investigations. In addition it may be mentioned that in some cases only a portion of the individuals found in the samples were investigated.

Several hundred additional specimens of this species from other samples were investigated. As, however, these investigations did not give any results beyond what are already shown in the above table, they were not included in it.

Mature females: In the first column of this table are included such females as have no eggs in the brood chambers, have very small eggs in the ovaries and have their natatory bristles on the exopodite of the second antennae broken off. They are specimens that evidently had recently laid a hatch of eggs. This is shown by the fact that the posterior parts of their bodies are pressed forward in the same way as in the females in whom the brood chambers are filled by the voluminous collections of eggs. — In the second column are included females whose brood chambers are filled with eggs; these eggs are often of rather different sizes in females of the same sample; the ovaries of these females contain very small eggs and their second antennae are distinguished by having their natatory bristles broken. The majority of the sexually mature females often seem to come into this category. — The females of the third column have no eggs in the brood chambers, have eggs in the ovaries and have the natatory bristles of the second antennae broken off. These females are distinguished from the females in the first column by not having the backs of their bodies pressed forward as in the females with their brood chambers filled with eggs. The eggs in the ovaries of these females are more or less developed, often very small. — The females in the fourth column are also without eggs in their brood chambers, the posterior parts of their bodies are not pressed forward as in the females of the two first categories; they have very small eggs in their ovaries and are characterized by long (unbroken) natatory bristles on their second antennae.

Mature males: These were always very rare in the bottom samples of this species stored in the Swedish State Museum. They were quite absent from about eighty per cent of all the bottom samples of this species investigated by me. The same state of affairs has been observed by the preceding writers, both with regard to this species and other species of this genus. Thus, for instance, W. LILLJEBORG writes with regard to *Ph. (Ph.) globosa*, 1853, p. 177, that among a very large number of females he observed only a single male. G. O. SARS, 1865, pp. 108 and 111 says about this species that while females occur in very great numbers, males are always extremely rare.

Larvae: Among the specimens of the first and second larval stage that were investigated by me the females and males were about equal in number.

All these facts strongly support the correctness of the above-quoted hypothesis put forward by G. W. MÜLLER in 1898 as to the reproductive oecology of this species.*

According to this hypothesis the specimens of the first to the fourth columns of the above table probably are to be interpreted in the following way:

1) The females of the fourth column represent specimens which have either not yet had their planktonic period, in other words have not yet been fertilized or else have just finished it.

2) The females in the third column are somewhat older; they have just definitely returned to a life of creeping and digging in the mud of the bottom owing to the breaking off of their natatory bristles on the second antennae.

3) The females in the second column are still older; eggs had been pressed out into their brood chambers for further development there.

4) The females in the first column are the oldest; their brood chambers had just been emptied.

The fact that the eggs in the ovaries of the females of the third column were often very small indicates that the natatory bristles are probably broken off fairly soon after fertilization.

With regard to the breaking off of the natatory bristles on the exopodite of the second antenna it is, as G. W. MÜLLER has pointed out, quite impossible that this is a case of accidental mutilation. This is supported, not only by the reasons given by this author, but also by the fact that the points of the bristles on the second to the fifth exopodite joint on this antenna are practically never broken, although they are very fine and although these bristles are often somewhat longer than the broken natatory bristles on the following joints. — With regard to the way in which the long natatory bristles are broken off nothing can be decided with certainty. It does not seem improbable to me, however, that G. W. MÜLLER's assumption that they are bitten off is correct. An investigation of these bristles on the females of the fourth category gave a negative result; no structural alteration could be observed in the region where the breaking off takes place.

What happens to a female after her brood chamber has been emptied?

It is perhaps too soon to give an opinion on this question. But it seems to me not improbable that they die rather soon afterwards. This is indicated by the fact that no moults seem to occur in the species of this genus after sexual maturity is attained. (Our knowledge in this respect is, however, very limited; cf. G. W. MÜLLER, 1894, p. 188.) Without any moult followed by a regeneration of the natatory bristles of the second antenna, it is, of course, impossible for these females to accompany the males when they soar aloft in the plankton. The possibility of fertilization during a continued life in the mud of the bottom is, of course, not excluded, but does not seem very probable. Nor is it impossible that a sufficient quantity of sperm remains in the receptacula seminis for the fertilization of a new hatch of eggs. Nor, of course, is the possibility of a parthenogenetic development of the eggs in the ovaries fully

* At about the same time as G. W. MÜLLER a Swedish scientist Professor J. G. ANDERSSON, who investigated the Ostracod material of the Swedish State Museum, put forward quite the same hypothesis; the results of his investigations, which are still in manuscript, were, however, never published. I too arrived at the same result quite independently of these two investigators.

excluded. The last-mentioned possibility seem, however, rather improbable because an attempt at parthenogenisis that was carried out by G. W. MÜLLER on a female of a nearly related species, *Ph. (Ph.) interpuncta*, had a negative result. (Cf. G. W. MÜLLER, 1894, p. 175.)

The males seem to die fairly soon after copulation. — This is supported by the two following circumstances: 1) Among the larvae the males and the females are found in about equal numbers, as has been pointed out above. Among the sexually mature specimens, on the other hand, the females predominate very strongly in number over the males, the latter being in most cases very rare. (I speak here of the bottom samples.) It does not seem probable that this scarcity is due to the fact that the mature males more frequently avoid being captured in the dredge owing to their greater rapidity. 2) The most important reason in favour of this assumption is, however, that when the males reach sexual maturity, their jaws are very much reduced, they become quite unfit for dissecting food — „welche beim Eintritt der Geschlechtsreife unfähig werden, Nahrung aufzunehmen", G. W. MÜLLER, 1894, p. 188. G. W. MÜLLER investigated, 1894, the stomachs of sexually mature males of this genus and found them empty. The same was also true of the stomachs of the male specimens of *Ph. (Ph.) globosa* investigated by me.

Another important result shown by the above table is that no clear periodicity can be observed in the appearance of this species:

1) Mature females with emptied brood chambers, the oldest specimens, were found in February, March, May, June, July, August and September.

2) Mature females with their brood chamber filled with eggs were found in all months, from January to September.

3) Mature females with broken swimming bristles on the second antenna and the eggs not yet pressed out into the brood chamber from February to September.

4) Mature females with long, unbroken swimming bristles on the second antenna in January, March, April, May, June and August.

5) Mature males in January, March, April, August and September.

6) Larvae in the first and second stages were found in all months from January to September except in February.

It is to be noted here that the only February sample that I had access to was very poor; it contained only the six specimens given in the table. This deficiency in individuals is certainly to be explained by the incompleteness of the collection. The sparse occurrence of young larvae in most of the samples investigated is certainly due to the same cause.

Unfortunately there were no samples from the last three months of the year. It seems, however, quite certain that all the categories mentioned are to be found also during these months.

The fact that mature males, which — as has been pointed out above — certainly live only a short time after the last larval moult, and females with long natatory bristles on the second antennae are to be found during all parts of the year definitely indicates that this species has no limited period for copulation; on the contrary, this fact makes it very probable that copulation takes place at all times of the year. Another consequence of this fact is, of course, that this species is to be found in the plankton during the whole year.

This result is obviously definitely opposed to the view quoted above as being put forward by C. APSTEIN, 1911, that *Ph. (Ph.) globosa* has a single planktonic copulation period limited to the months of April, May and June.

On account of this I carried out new investigations concerning this problem. In the first place I investigated about a hundred plankton samples, taken during January, February, May and July at Skager Rak and Cattegat by the investigation vessel „S k a g e r a k" for the „Swedish Hydrographical Biological Commission". Secondly the plankton tables published by the „Conseil permanent international pour l'exploration de la mer", on which C. APSTEIN had founded his view, were subjected to a renewed and careful investigation.

The results of the first investigation seemed to support the view put forward by APSTEIN. In all the samples from January, February and July this species was quite absent. Only in a few samples from the month of May, consequently within the period suggested by APSTEIN, did I succeed in finding it. Both males and females were discovered. This is interesting because the literature so far published does not clearly show whether both sexes are found swimming freely in the higher layers of the water. The results are shown in the following table:

	Surface	20 m.	25 m.	A few metres from the bottom
Outside Varberg 8. V. 1912, 11—12 p. m.	21 ♂, 1 ♀	0	3 ♂, 2 ♀	33 ♂, 2 ♀
Outside Varberg 9. V. 1912, 1—2,30 a. m.	68 ♂, 1 ♀	10 ♂	0	65 ♂, 1 ♀
At Anholt 28. V. 1912, 1,30—1,50 a. m.	0	0	0	2 ♂

The small number of females seems to indicate that the females return to the bottom more rapidly than the males.

The following are the results of my re-examination of the plankton tables published by the „C o n s e i l   p e r m a n e n t":

Philomedes (Ph.) globosa is stated in these tables to have been caught at the following stations on the following occasions: (The same terms are used in my work as those in these tables: cc means very common, c common, + „neither common nor rare", r rare, rr very rare, — means that the species was not found).

1903: May: Da 7, lat. 57° 52′ N., long. 11° 18′ E., depth to the bottom = 87 m.

2. V., 1 h 10 a. m. — 2 h 20 a. m.

75 m. — 45 m. rr.

65 „ — 0 „ +

10 „ — 0 „ rr.

0 „ +.

Da. 18, lat. 56° 47′ N., long. 11° 47′ E., depth to the bottom = 50 m.

1. V., 8 h p. m. — 8 h 35 p. m.

50 m. — 20 m. —
50 „ — 0 „ !
15 „ — 0 „ —
0 „ r.

D. N. 9, lat. 57° 52′ N., long. 7° 20′ E., depth to the bottom = 463 m.

3. V., 7 h a. m. — 10 h a. m.

430 m. — 150 m. —
150 „ — 75 „ —
75 „ — 40 „ —
40 „ — 5 „ —
5 „ — 0 „ —
0 „ c.

Sc. 16, lat. 61° 46′ N., long. 5° 50′ W., depth to the bottom = 116 m.

30. V., 3 h p. m.

100 m. — 0 m. —
0 „ rr.

Da. Atl. 2, lat. 62° 34′ N., long. 6° 20′ W.; depth to the bottom = 115 m.

7. V., 10 h 25 a. m. — 10 h 50 a. m.

100 m. — 55 m. —
100 „ — 0 „ —
45 „ — 0 „ —
0 „ rr.

August:

D. N. 9, lat. 57° 52′ N., long. 7° 20′ E.; depth to the bottom = 468 m.

9. VIII., 6 h a. m.

450 m. — 300 m. rr.
300 „ — 0 „ —
450 „ — 20 „ —
20 „ — 0 „ —
0 „ —

1904: February:

S. 1, lat. 58° 03′ N., long. 10° 48′ E.; depth to the bottom = 205 m.

16. II., 5 h a. m.

130 m. — 60 m. —
60 „ — 30 „ —
30 „ — 0 „ —
0 „ —

S. 2, lat. 57° 53′ N., long. 10° 42′ E.; depth to the bottom = 126 m.

16. II., 8 h 45 a. m.

100 m. — 0 m. —
50 „ — 0 „ r.
0 „ —

S. 5, lat. 57° 42′ N., long. 9° 51′ E.; depth to the bottom = 78 m.

16. II., 1 h 40 p. m.

60 m. — 0 m. —
30 „ — 0 „ rr.
0 „

May:

S. 2, lat. 57° 52′ N., long. 10° 42′ E.; depth to the bottom = 135 m.

10. V., 4 h 10 p. m.

132 m. — 0 m. —
135 „ — 60 „ —
60 „ — 0 „
0 „ r.

S. 13, lat. 58° 36′ N., long. 9° 20′ E.; depth to the bottom = 342 m.

12. V., 2 h p. m.

250 m. — 0 m. —
240 „ — 100 „ —
100 „ — 0 „
0 „ r.

Da. 4, lat. 57° 57′ N., long. 10° 49′ E.; depth to the bottom = 180 m.

1. V., 7 h 40 p. m.

175 m. — 0 m.
170 „ — 0 „ —
100 „ — 0 „ rr.
20 „ — 0 „ —
0 „ +

Da. 7, lat. 57° 52′ N., long. 11° 18′ E.; depth to the bottom = 90 m.

2. V., 4 h a. m.

90 m. — 0 m. rr.
80 „ — 0 „ r.
50 „ — 0 „ —
20 „ — 0 „
0 „ —

Da. 20, lat. 56° 22′ N., long. 11° 48′ E.; depth to the bottom = 28 m.

1. V., 11 h 40 p. m.

28 m. — 20 m.

28 ,, — 0 ,, rr.

10 ,, — 0 ,, —

0 ,, cc.

Da. 21, lat. 56° 07′ N., long. 11° 11′ E.; depth to the bottom = 34 m.

2. V., 4 h a. m.

34 m. — 15 m.

34 ,, — 0 ,, rr.

10 ,, — 0 ,,

0 ,, rr.

1905: May:

Da. 4, lat. 57° 57′ N., long. 10° 49′ E.; depth to the bottom = 174 m.

1. V., 5 h 40 a. m.

174 m. — 0 m. r.

150 ,, — 0 ,,

140 ,, — 0 ,,

75 ,, — 40 ,,

30 ,, — 12 ,,

10 ,, — 0 ,, —

0 ,, r.

Da. 7, lat. 57° 52′ N., long. 11° 18′ E.; depth to the bottom = 90 m.

1. V., 5 h 30 p. m.

85 m. — 0 m. —

75 ,, — 30 ,, rr.

20 ,, — 0 ,,

0 ,, r.

1906: February:

S. 7, lat. 58° 26′ N., long. 9° 44′ E.; depth to the bottom = 673 m.

13. II., 10 h 30 a. m.

0 m. rr.

S. 16, lat. 58° 19′ N., long. 11° 32′ E.; depth to the bottom = 116 m.

10. II., 4 h 30 p. m.

0 m. r.

May:

S. 3, lat. 58° 11′ N., long. 10° 29′ E.; depth to the bottom = 229 m.

21. V., 9 h 40 a. m.

125 m. — 12 m. rr.

S. 10. lat. 58° 48′ N., long. 10° 23′ E.; depth to the bottom 157 m.

21. V., 4 h 15 p. m.

5 m. rr.

1907: February:

Se. 23. lat. 59° 31′ N., long. 0° 37′ E.; depth to the bottom 138 m.

24. II., 6 h 30 p. m.

138 m. rr. (Evidently a bottom sample.)

May:

D. N. 6. lat. 57° 55′ N., long. 4° 45′ E.; depth to the bottom 103 m.

8. V., 10 h p. m.

0 m. The abundance not stated.

D. N. 9. lat. 57° 52′ N., long. 7° 20′ E.; depth to the bottom 445 m.

11. V., 11 h 15 a. m.

430–150 m. The abundance not stated.

Da. 18. lat. 56° 47′ N., long. 11° 47′ E.; depth to the bottom 43 m.

1. V., 5 h 30 p. m.

40 m. – 0 m. r.

0 „ r.

1908: May:

Se. 36. lat. 58° 26′ N., long. 0° 08′ W.

0 m. r.

June:

Se. 16. lat. 62° N., long. 6° 12′ W.; depth to the bottom 112 m.

9. VI.

0 m. r.

In other words it was found in plankton during the time from August 1902 to May 1908 in „Danish Seas" (Skager Rak, Cattegat, The Great and Little Belt)

nine times during May

Skager Rak (Swedish portion)

five times during February

four „ „ May

North Sea (German portion)

three times during May

once „ August

North Sea (Dutch portion)

never

North Sea (Belgian portion)

never

North Sea (Scottish portion)
twice during May*
once „ June
English Channel
never
Atlantic (Danish portion)
once during May
Atlantic (Norwegian portion)
never
Arctic Ocean (Russian portion)
never.

During this time the following numbers of stations were investigated:

	February	May	August	November
„Danish Seas"	48	57	46	61
Skager Rak, Swedish portion	48	76	75	62
North Sea, German „	59	103	75	75
„ „ Dutch „	45	45	36	45
„ „ Belgian „	48	53	64	66
„ „ Scottish „	88	182	143	91
English Channel	157	170	144	140
Atlantic, Danish portion		51	46	-
„ Norwegian „	12	89	12	—
Arctic Ocean, Russian portion	—	8	53	—

This species was thus caught during the month of February at five out of 505 stat.
„ „ „ „ May „ twenty**„ „ 834 „
„ „ „ „ August „ one „ „ 694 „
„ „ „ „ November „ none „ „ 540 „

As is shown by the extracts given above from the plankton tables we are concerned in most cases with finds containing a very few individuals, only on a few occasions during May and February are there more abundant finds.

It seems to be shown quite clearly from these statements that these tables cannot be considered as supporting the view put forward by C. Apstein of a limited planktonical copulation period; the finds made are too sporadic for this.

A decided argument against this writer's view is the fact that the species was found in plankton at five stations during the month of February. It is beyond all doubt that in this case there can be no question of „das Aufsteigen unreifer Exemplare infolge besonderer hydro-

* The statement with regard to February refers to a benthonical find. Cf. above.

** In this number is included the June find.

graphischen Verhältnisse", as APSTEIN suggests. During February 1904 we are concerned with an ascent to the surface of the water from a depth of 205 m. (at Stat. S. 1), to 50—0 m. from a depth of 126 m. (at Stat. S. 2) and to 30—0 m. from 78 m. (at Stat. S. 5); during February 1906 there was an ascent to the surface of the sea from 673 m. (Stat. S. 7) and from 116 m. (Stat. S. 16). An ascent of this sort is certainly altogether too difficult for larvae which have no power of swimming, even if the hydrographic conditions were very unfavourable!

On account of these facts and the facts shown in the table worked out by me and given on p. 354, it seems to me probable that, as has been stated above, this species copulates during all parts of the year.

It seems strange that *Ph. (Ph.) globosa* is so seldom met with in the plankton. This is shown by the preceding literature as well. As instances I need only mention here that C. W. S. AURIVILLIUS found this species only on a single occasion (during the month of July) in Baffin's Bay (C. W. S. AURIVILLIUS, 1896, p. 211) and that the same writer did not find this species planktonically in Skager Rak, in spite of careful studies of the plankton of this sea during several years; the samples were taken during all the months of the year (C. W. S. AURIVILLIUS, 1898). I may also here mention the fact that I only found this species in Skager Rak and Cattegat in a few out of about a hundred samples of plankton from January, May and July (cf. p. 358).

What is the cause of this phenomenon?

This seems to be very difficult or perhaps it would be more correct to say impossible to decide with certainty at the present time. The fact that all the samples of plankton in which I found this species were taken during the darkest part of the night, while the greater part of the samples which did not contain this species were collected during the day first led me to assume that the copulation of this species took place principally during the night. This assumption seemed also to be supported by the statements of preceding writers. Thus, for instance, G. S. BRADY writes, 1868 b, p. 464 of *Ph. (Ph.) interpuncta* that it was „taken abundantly in the towing-net at Cumbrae, chiefly at night time". G. W. MÜLLER writes 1894, p. 14 with regard to the Cypridinids: „Wenn man sie gelegentlich freischwimmend in der Nähe der Küste gefunden hat, so handelt es sich dabei um ein zeitweises Aufsteigen, das vorwiegend bei Nacht zu erfolgen scheint."

The extracts given above from the plankton tables published by the „Conseil permanent" show, however, with all desirable clearness that this explanation is not correct. The hauls included in these tables are distributed fairly equally over the twenty-four hours of the day.

It seems most probable to me that the explanation of this phenomenon is to be found, first, in the fact that the planktonic period of each individual is very short and, secondly, that, as in the case of termites and ants, with the wings of which G. W. MÜLLER, as we have seen above, has compared the long natatory bristles of the second antenna of this species — the swarming individuals appear in flocks. An appearance in flocks would of course greatly decrease the chances of catching the species in the plankton nets. The idea that this species appears in flocks during its planktonic period seems to be supported especially by the samples from D. N. 9, 3. V. 1903, S. 1, 16. II. 1904, Da. 4, 1. V. 1904 and Da. 20, 1. V. 1904. At all these stations this species was found abundantly or even very abundantly in a single sample

while, on the other hand, in the other samples it was not found at all or only very sparsely. At the last-mentioned station, for instance, no specimen was found in the samples from 28 to 20 m. and 10—0 m., only a few individuals were caught in the sample from 28—0 m.; in the sample from the surface, on the other hand, a very great many individuals (cc) were found.

Does planktonic copulation occur in other species of this genus besides *Ph. (Ph.) globosa*? *Other species of the genus.*

No investigations in this direction have as yet been carried out, but it seems rather probable that this question is to be answered in the affirmative. This assumption is supported partly by the fact that a number of other species of this genus have been found in the plankton, partly by the fact that some of the other species of this genus are characterized by the circumstance that the females with eggs in the brood chamber have the long natatory bristles of the second antenna broken in the same way as in *Ph. (Ph.) globosa.*

The following species have been caught in the plankton: (No information is to be found as to whether females of these species have been found together with the males,)

Ph. (Ph.) Lilljeborgi:

The following finds of this species are given in the plankton tables published by the „Conseil permanent“:*

1903:

May: N. 2, lat. 61° 17′ N., long. 3° 22′ E.; depth to the bottom, 380 m.

22. V., 10 h p. m. — 12 h p. m.

0 m. c.

100 m. — 0 ,, c.

June: N. 24, lat. 67° 11′ N., long. 10° 26′ E.; depth to the bottom, 223 m.

1. VI., 10 h 15 p. m. — 11 h 30 p. m.

0 m. +

25 m. — 0 ,, —

100 ,, — 0 ,, —

August: N. 2, lat. 61° 22′ N., long. 3° 08′ E.; depth to the bottom, 380 m.

9. VIII., 6 h 10 p. m.

0 m. —

25 m. — 0 ,, r.

50 ,, — 30 ,, r.

200 ,, — 100 ,, —

1910:

At Anholt, lat. 56° 46′ N., long. 11° 51′ E. (There is no information as to depth, etc.)

May: 1. V. rr.

July: 1. VII. rr.

August: 15. VIII. rr.

November: 15. XI. rr.

* This species is also stated to have been found at the station Sk. 8 of the „Conseil permanent“, lat. 61° 30′ N., long. 3° 03′ E., at a depth of 375 m., 28. VIII. 1907. This statement, however, clearly refers to a [illegible]

1911:

At the same station. (There is no information as to depth, etc.)

April: 1. IV.

H. H. GRAN writes as follows about this species, 1902, p. 67: „. . . aber die geschlechtsreifen Männchen schwärmen umher im freien Wasser, wo sie an Norwegens Küsten besonders im Winter und Frühling in großer Menge ganz an der Oberfläche angetroffen werden können."

These facts show that this species, like the preceding one, is as a rule very rarely found in plankton (it is to be mentioned that it is also rather rare in the bottom samples, much more uncommon than *Ph. (Ph.) globosa*) though it certainly exists there in rather great numbers, and that it is found planktonically at all times of the year.

Ph. (Ph.) interpuncta:

G. S. BRADY writes 1868 b, p. 464 that this species was „taken abundantly in the towing-net."

In the plankton tables of the „C o n s e i l p e r m a n e n t" this species is only mentioned once:*

1906:

November: Sc. 32, lat. 58° 08′ N., long. 2° 00′ W.; depth to the bottom 80 m.

10 m. rr.

Ph. (Ph.) Macandrei:

This species was also caught in the plankton only on one occasion by the „C o n s e i l p e r m a n e n t":

1905:

August: Sc. 5 A., lat. 60° 05′ N., long. 0° 48′ W.; depth to the bottom, 111 m.

0 m. +.

Besides *Philomedes (Ph.) globosa* two of the species of this genus that I have had an opportunity of investigating, *Ph. (Ph.) rotunda* and *Ph. (Scleroconcha) Appellöfi*, were characterized by always having the long natatory bristles of the second antenna of the females with eggs in the brood chamber broken in the same way as is described above for the first-mentioned species.

In the case of *Ph. (Ph.) Lilljeborgi*, among the specimens investigated by me, some females — both from Lofoten and from Skager Rak — with eggs in the brood chamber had long, unbroken natatory bristles on the second antenna; most females of this kind were, however, characterized by having these bristles broken in the same way as in the three preceding species.

Ph. (Ph.) Eugeniae, on the other hand, always had long, unbroken natatory bristles on the second antenna in the females with eggs in the brood chamber which I have examined.

One other species of this genus, which is not included in this treatise, namely *Ph. (Scleroconcha) Folini*, was investigated by me with regard to this character. In the description that G. O. SARS, 1887, pp. 52 and 53, gives of the second antenna in the female of this species we read the following statement: „2det Par Antenner hos Hunnen viser vistnok idethele samme

* A form named *Philomedes interrupta* is also mentioned in these tables (North Sea, B, August, 1906), but as no species of this name is hitherto described I leave this find out of consideration (= *Ph. (Ph.) interpuncta?*).

Bygning som hos de 2 foregaaende Slaegter; men de er forholdsvis mindre kraftigt udviklede, og de til Svommegrenen faestede Børster er ualmindelig korte, med Cilieringen grovere og mindre taet. I Virkeligheden kan disse Lemmer hos Hunnen kun uegentlig kaldes Svømmeantenner, da de ikke benyttes til Svømning, men kun som et Slags Arme . . . . ved Dyrets langsomme krybende Bevaegelser paa Havbunden."* The drawing with which G. O. SARS illustrates this description shows an antenna of about the same structure as the larval one, i. e. with relatively short, unbroken bristles, well pointed distally, on the exopodite; curiously enough in this drawing all the bristles of the exopodite have natatory hairs. From this description and figure it seemed to me probable that the peculiarity of breaking-off the natatory bristles would also be a characteristic of this species. In order to be absolutely certain on this point I wrote to Professors G. O. SARS and G. S. BRADY asking for permission to investigate their specimens. Both these investigators were kind enough to send me several specimens. Among the specimens sent by Professor SARS there was only one (probably) mature female; this specimen unfortunately, however, was represented only by two empty valves. Among Professor BRADY's specimens there was a complete female with very large eggs in the brood chamber. Contrary to G. O. SARS's statement this specimen had, on the exopodite of the second antenna, like *Ph. (Scleroconcha) Appellöfi*, relatively short and quite bare bristles on the second to the fourth joints; the bristles on the following joints were long natatory bristles of the same type as in the female of *Ph. (Ph.) globosa* during its pelagian stage.

What is the connection between these facts and the view put forward by G. W. MÜLLER, 1908, that the peculiarity of breaking off the natatory bristles in the genus *Philomedes* is not a phenomenon of convergence, but that it is to be referred to a common inheritance?

The breaking off of the natatory bristles a phenomenon of convergence.

It is obviously difficult to fit them in with this theory. *Philomedes (Scleroconcha) Appellöfi* and *Ph. (Ph.) rotunda* represent two types rather strongly differentiated from *Ph. (Ph.) globosa* and *Ph. (Ph.) assimilis*; the first-mentioned species especially differs comparatively greatly from the others. In all these four forms the natatory bristles are broken off. In *Ph. (Ph.) Eugeniae*, which is certainly very closely related to *Ph. (Ph.) globosa* and *Ph. (Ph.) assimilis*, and in *Ph. (Scl.) Folini*, which is very closely related to *Ph. (Scl.) Appellöfi* the natatory bristles remain unbroken throughout the whole life.

Contrary to G. W. MÜLLER's view, it seems to me necessary to assume that the peculiar character of breaking off the natatory bristles of the exopodite of the second antenna in the genus *Philomedes* is not the result of common inheritance but of convergence.

It is of course impossible at the present time to give any certain causes for this phenomenon. The following facts are, however, striking:

1) All the species (five) of this genus from warm or temperate seas that were investigated with regard to this character proved to have long, unbroken natatory bristles during the whole year.

* The second pair of antennae in the female certainly show, on the whole, the same structure as in the two preceding genera, but they are comparatively less powerfully developed, and the bristles that are attached to the natatory branch are unusually short, with their hairs coarser and situated less densely. As a matter of fact these limbs in the female cannot really be called swimming antennae, as they are not used for swimming, but only as a sort of arms . . . . in the animal's slow crawling movements at the bottom of the sea.

2) Of the six species of this genus known from colder seas (Arctic and Antarctic) four* are characterized by having these bristles broken off in older females.

These facts indicate that external, climatic factors have perhaps caused this peculiar convergence.**

It does not seem impossible that in the case of species which are characterized by having the natatory bristles of the second antenna unbroken throughout the whole life the females are impregnated several times. The statement made by G. W. MÜLLER, 1894, p. 174, according to which *Ph. (Ph.) interpuncta* lays at least two lots of eggs, seems to me to support this.

Genus Philomedes W. LILLJEBORG.

Cypridina (part.) autorum: e. g. W. BAIRD, 1850 a and FR. MÜLLER, 1870. *Asterope*, S. FISCHER, 1855. *Philomedes* (= ♂) + *Cypridina* (= ♀ and juv.), W. LILLJEBORG, 1853. *Philomedes* (= ♂) + *Bradycinetus* (= ♀ and juv.), G. O. SARS, 1865; G. S. BRADY, 1868 b and 1871. *Philomedes* (= ♂, ♀ and juv.) autorum; e. g. G. O. SARS, 1869 and 1887; G. W. MÜLLER, 1894; G. S. BRADY and A. M. NORMAN, 1896. *Philomedes* (part.), G. W. MÜLLER, 1912.

With regard to the relation of *Pleoschisma* and *Tetragonodon* to this genus cf. above the remark below the sub-family.

Diagnosis: — Cf. G. O. SARS, 1887, p. 45 and G. S. BRADY and A. M. NORMAN, 1896, p. 653.

Description: — Shell: — This has marked sexual dimorphism.

Female: — The shape of the shell varies rather considerably. The rostral incisur is of a somewhat varying type, but is most frequently deep and narrow. The sculpture of the surface seems in most cases to be very weakly or even not at all developed; in some cases, on the other hand, it is very powerful. Seen from inside: The part of the shell between the list and the posterior margin of the shell is flattened and not curved in like a siphon, so that the two valves are near each other at this part when the shell is closed; only in exceptional cases is there any indication of a siphon: (cf. the description of *Ph. (Scleroconcha) Appellöfi*). Medial bristles: These had in the species investigated by me almost exactly the same type: On the rostrum there was a row running at some distance from and almost parallel to the ventral part of the anterior margin of the rostrum sometimes continuing a little way along the anterior margin of the rostral incisur. Most of these bristles were rather long and finely feathered;

* It may be pointed out that *Ph. (Ph.) orbicularis*, a species from the Antarctic, described by G. S. BRADY, which is certainly very closely related to *Ph. (Ph.) rotunda*, has, according to this author's drawing, 1907, pl. I, fig. 8, long unbroken natatory bristles on the second antenna; there is, however, no information as to whether the female from which the antenna that is reproduced was taken had eggs in the brood chamber or if it was still in the plankton stage.

** See R. HESSE und F. DOFLEIN, „Tierbau und Tierleben", 1914, II, p. 876.

some of their distal hairs were long (about the same as in fig. 6 of *Ph. (Ph.) Lilljeborgi*); the most posterior-ventral bristles in this row are, however, sometimes almost completely smooth. Inside the inner edge of the rostral incisur, somewhat posteriorly, there is a short, simple bristle. Apart from these the rostrum and the part round the incisur are quite without bristles. A short distance behind the incisur on a rather short part of the list there is a somewhat varying number (about ten to twenty) of moderately long and finely feathered bristles; apart from these the list is almost entirely without bristles along the ventral margin of the shell; inside the posterior margin of the shell it has a moderate number of rather short, smooth, fine bristles. Along the ventral margin of the shell the list is narrow, posteriorly it is somewhat wider. The selvage is almost exactly similar in all the species of this genus that have been investigated by me. It is well developed both on the rostrum and along the whole ventral side of the shell; on the rostrum and along the edges of the incisur it is very wide (the incisur is quite filled by it), but it is also rather wide along the whole ventral margin of the shell. On the rostrum and along the edges of the incisur it is divided by a coarse striation into narrow rectangular portions; this coarse striation gradually comes to an end, however, behind the incisur; along its whole length the selvage is also finely cross-striated; this cross-striation is, however, sometimes rather difficult to verify with certainty at certain parts. On the rostrum the selvage has at the edge rather fine hairs (cf. fig. 4 of *Ph. (Ph.) Lilljeborgi*) which vary in length; on the part along the posterior edge of the incisur and just behind the incisur there are, in addition to such short hairs, rather long marginal hairs as well, and, besides, issuing at about half the breadth of the selvage, there are often a number of comparatively long bristles. Along the ventral margin of the shell the selvage is also divided at the edge into short, fine hairs of different lengths; on the posterior part they are somewhat shorter and more equal in length than they are anteriorly (see fig. 3 of *Ph. (Ph.) Lilljeborgi*). (In the specimens of *Ph. (Scleroconcha) Appellöfi* I have had an opportunity of investigating the selvage was very much worn, so that all the details given here — reproduced for *Ph. (Ph.) Lilljeborgi* — could not be verified with absolute certainty for them.) Inside the list a part of the inner lamella of the shell just behind the rostral incisur is characterized by about nine to twelve striae, situated close together and running parallel to the margin of the shell (see fig. 2 of *Ph. (Ph.) Lilljeborgi*). With strong calcareous incrustation. The forms are rather large or of moderate size.

M a l e: — This differs from that of the female especially by being considerably more elongated and by having the rostral incisur considerably more shallow and wider. The two sexes also seem to differ a good deal in length. The male shell is less strongly calcified. In those cases in which a strongly marked sculpture is present it is less developed in this sex.

F i r s t a n t e n n a: — This has strong sexual dimorphism.

F e m a l e: — This is relatively short and has six joints. The original fifth joint is not developed; whether, as G. W. MÜLLER states, 1894, p. 23, the fourth joint has arisen by the uniting of the original fourth and fifth joints seems to be very difficult to decide with certainty at present; judging from the situation of the bristles the original fifth joint seems, at any rate in this genus, to be very much reduced and it does not seem impossible that it has been eliminated, at least in some forms, an assumption that seems to be supported by a comparison with the

male first antenna. The original seventh and eighth joints are strongly, presumably completely immoveably, united to each other; the original boundary between them can, however, be clearly observed. The proportions between the joints seem to be subject only to slight variation; the conditions in the forms investigated by me were about as follows (the figures are taken from measurements of *Ph. (Ph.) globosa*):

$$\mathrm{I}\,\tfrac{11}{12} : \mathrm{II}\,[illegible] : \mathrm{III}\,[illegible] : \mathrm{IV}\,[illegible] : \mathrm{V}\,[illegible] : \mathrm{VI}\,[illegible].$$

With regard to the equipment of bristles on this antenna a rather slight amount of variation was observed in the species dealt with in this treatise. On account of the uncertainty of the statements in the literature attention is paid below only to the conditions in these species that I have verified myself. The second joint has three bristles, all situated near the distal boundary of the joint, one anteriorly, one posteriorly and one laterally. The third joint has one bristle distally-posteriorly and a somewhat varying number (from two to four were observed) situated in most cases distally-anteriorly. The fourth joint has four bristles distally-posteriorly and one or two bristles distally-anteriorly. The original fifth joint is quite without the sensory bristle that is characteristic of most other genera of this family. All the bristles mentioned so far, like that on the original sixth joint, are of about the same type: They are of the ordinary type, with short hairs distally and furnished in most cases with one or more wreaths of long, stiff secondary bristles near the middle; in some cases, often not quite constantly, the long secondary bristles may be missing on one or two of these bristles; the length of these bristles is somewhat different in different species. On the end joint eight bristles are to be observed, thus one more than on the seventh and eighth joints in the sub-family *Cypridininae*. Four of these bristles are situated on the original seventh joint, four on the original eighth joint. The bristles on the former of these two joints are situated as follows: one is situated anteriorly, one medially and somewhat anteriorly, two posteriorly. The anterior one of these bristles is of the same type as the bristles on the preceding joints. The medial one is a typical sensory bristle; it is about as long as the anterior sides of the second and third joints; it is powerfully annulated proximally, the annulation becomes weaker distally and may even almost disappear; on its anterior side this bristle has a few very fine sensorial filaments, of equal thickness throughout, hyaline or only weakly and finely annulated and bare; distally these sensorial filaments are somewhat rounded and provided with a short, fine (sensory?) hair; one or two of these filaments were observed near the middle of the bristle and three close together near its distal point. The two posterior bristles of the original seventh joint are of about the same type as the last-mentioned bristle, but differ from it by having a somewhat larger number of anterior sensorial filaments: five to seven proximal ones and four distal ones were observed. The four bristles of the original eighth joint have the same positions as in the sub-family *Cypridininae*. All four are subequal or differ only very slightly in length; they are about as long as the two posterior bristles of the original seventh joint. The two that are situated close to each other laterally are simple, rather narrow, of about equal thickness throughout, bare, rather finely annulated sensorial filaments as in the sub-family just mentioned. The two bristles that are situated more medially are of the same type as the two posterior ones on the original seventh joint; on the anterior one of

them four to six proximal and four distal sensorial filaments were observed, on the posterior one three to six proximal ones and four distal ones.

M a l e: — This is somewhat more elongated than that of the female; as an instance it may be mentioned that some males of *Ph. (Ph.) globosa* with shells about 3 mm. long had first antennae about 1,8—1,9 mm. long, while on some females of the same species with about the same length of shell as the above-mentioned males this limb was only about 1,4—1,6 mm. It has six joints. The original fifth joint is represented by a small, reduced part, most strongly developed posteriorly (where the sensory bristle of the fifth joint is attached); it is in most cases rather clearly defined from the fourth joint (cf. the accompanying figure 8 of *Ph. (Ph.) globosa*), but it might perhaps, all the same, be convenient to follow G. W. MÜLLER and not to take this part as a special joint. The original eighth joint is somewhat displaced laterally; traces of a union between this joint and the original seventh joint can still be observed. The proportions between the joints seem to be fairly constant and about as follows; (the figures are taken from measurements of *Ph. (Ph.) globosa*:

$$\mathrm{I}\ {}^{15}_{11}:\ \mathrm{II}\ {}^{20}_{14}:\ \mathrm{III}\ {}^{\text{[illegible]}}_{4}:\ \mathrm{IV}\ {}^{\text{[illegible]}}_{6}:\ \mathrm{V}\ {}^{\text{[illegible]}}_{5}:\ \mathrm{VI}\ {}^{4}_{7}.$$

The comparatively strong development of the end joint seems to be specially noticeable. Bristles: In this sex, contrary to the female, there is found on the part that has been stated above to be the remains of the original fifth joint a very well-developed posterior sensory bristle. This sensory bristle seems to be developed in about the same way in all the species of this genus; it is about as long as the anterior side of the second joint, is rather thick and is strongly annulated proximally, grows very narrow distally and is very finely annulated there or quite hyaline; on its posterior side it has, along the proximal half, very numerous thin bare, distally rounded sensorial filaments, of about a uniform thickness throughout and ending with a short, fine hair; in most cases these filaments are somewhat more than half the length of the bristle; on the distal half this bristle has only a few sensorial filaments of the same type as the proximal ones, but considerably shorter. With the exception of this bristle the second to the fifth (definitive) joints have the same bristles as these joints on the female first antenna and these bristles show in most cases about the same type in both sexes. The end joint has the same number of bristles as in the sub-family *Cypridininae*, i. e. seven, three of which are, as in this sub-family, attached to the original seventh joint, four to the original eighth joint; only one posterior bristle is developed in this sex on the original seventh joint. With regard to their types they show rather close agreement with the corresponding bristles in the female; in length they are, however, very dissimilar, as the anterior and medial bristles of the original seventh joint and the two lateral and the posterior medial bristles on the original eighth joint are rather considerably shortened, while the posterior bristle of the original seventh joint and the anterior-medial bristle of the original eighth joint are very much lengthened; the two latter bristles are about as long as the shell. The number of sensorial filaments on the bristles of the end joint is often different in the two sexes.

S e c o n d a n t e n n a: — This shows strong sexual dimorphism.

F e m a l e: — The p r o t o p o d i t e has no bristles. The e x o p o d i t e is somewhat longer than the protopodite (exopodite : protopodite about [6—7] : 5). The proportion between the joints is about the same in all species:

I : II : III : IV : V : VI : VII : VIII : IX = approximately 41 : 9 : 5 : 4 : 4 : 4 : 4 : 4 : 3.

i. e. the first joint is somewhat longer than the total length of all the other joints; the second joint is about as long as or somewhat shorter than the total length of the third and fourth joints. The first joint has ventero-distally a very short, almost spine-like, bare bristle. The bristles on the second and the third, the second to the fourth or even the second to the fifth joints are all of the same type and length, being about as long as the first to the third proximal joints, and rather powerful, pointed, bare or furnished with short spines. The bristles on the other joints are, with the exception of a few of the bristles on the end joint, long and powerful natatory bristles, most of them of about the same size, with rather long and wide natatory hairs along the greater part of their length, without any spines, not hyaline distally nor having any structure there indicating a sensory function. The end joint has more than four bristles, of which some of the dorsal-medial ones are comparatively short. Sometimes basal spines are developed, sometimes they are not present; the end joint never seems to be furnished with any of these. The second to the eighth joints are provided distally, both on the lateral and the medial sides, with a close series of short, often rather fine, hairs, those situated on the medial side being often somewhat longer; sometimes some transverse rows of short, fine hairs can also be observed on the distal part of the first joint. The e n d o p o d i t e is always small and weak, more or less distinctly two-jointed. The first joint is short and wide; the boundary between it and the protopodite is often difficult to determine; it is furnished with some short bristles. The second joint is somewhat longer; its equipment of bristles varies; it always has a single bare (sensory?) bristle distally.

M a l e: — The p r o t o p o d i t e is considerably more powerful than that of the female; as an example it may be mentioned that in some males of *Ph. (Ph.) globosa* with shells about 2.6—2.7 mm. long this joint was about 1.1 mm. long, while in some females of the same species with the same length of shell it was only about 0.8—0.9 mm. The e x o p o d i t e is somewhat longer than the protopodite; the proportion between it and this joint is about the same as in the female. The third joint or sometimes the second and third joints are rather considerably lengthened. The first joint is without bristles (always?). The bristle on the second joint is comparatively short, being about as long as the first joint, pointed, bare or furnished with short spines. The bristles on the other joints, with the exception of a few on the end joint, are long natatory bristles. The e n d o p o d i t e is developed as a powerful organ for seizing the female. It has three joints, the two distal ones are very much lengthened, the end joint may be folded in against the preceding joint. The first joint is rather slightly lengthened and has about the same equipment of bristles as in the female. The second joint has some bristles ventrally at the middle. The end joint has one bristle near the proximal boundary and distally it has two very short and somewhat sunken bristles situated close to each other. In other respects this limb agrees with that of the female.

M a n d i b l e: — This shows considerable sexual dimorphism.

F e m a l e: — This is rather long and very powerful. The e n d o p o d i t e is rather decidedly flattened at the sides, its second joint is only slightly narrowed distally. The pro-

portion between the joints seems to be fairly constant; the following figures may be given to illustrate it (from a specimen of *Ph. (Ph.) globosa*):

$$\text{Pr. I } \tfrac{32}{32},\ \text{Pr. II } \tfrac{29}{32},\quad \text{End. I } \tfrac{16}{11},\ \text{End. II } \tfrac{28}{21},\ \text{End. III } [illegible].$$

(It thus differs from the mandible in *Cypridininae* especially by the relatively great length of the first endopodite joint and the relative shortness of the second endopodite joint.) P r o t o p o d i t e: The endite of the coxale is moderately large but very powerful and is deeply bifurcated distally; the two main points are rather strongly chitinized, well pointed and most frequently furnished with some moderately strong secondary spines (see fig. 8 of *Ph. (Sclero-concha) Appellöfi*); it is furnished with a moderate number of rather long and stiff hairs arranged in a few groups; in addition it has proximally-laterally a single short bristle, apart from which this joint has no bristles. Basale: On the inside of the proximal half of the joint there is a group of rather short bristles, some of which are powerful; in all the species of this genus that are dealt with in this treatise this group had six bristles, three of which were powerful, furnished with powerful secondary teeth, the three others were moderately strong and had a wreath of long, stiff secondary bristles at the middle and short hairs distally. Scattered along the ventral side of this joint there is a somewhat varying number of bristles; in the species investigated by me from six to twelve bristles were observed at this place, all of the same type, having one or a few wreaths of long, stiff secondary bristles at the middle and short hairs distally, of moderate length or rather long. Dorsally this joint has a varying number of rather long bristles, two of which are always situated distally close to each other. The e x o p o d i t e is, in most cases, somewhat shorter than the dorsal side of the first endopodite joint. It is drawn out to a rather fine point and has dorso-distally a sort of cushion of exceedingly fine hairs situated close together (the mouths of a gland). E n d o p o d i t e: The first joint has four ventral distal bristles, some or all of which are long. Second joint: On the anterior side this joint has a number of bristles, situated in two more or less distinct groups, one of which is placed about half-way along the joint, the other somewhat proximally of this. The bristles in the latter group seem to vary rather considerably in number and type. The former group, on the other hand, had, in all the species investigated by me, six bristles, all rather long but differing somewhat in length, the longest ones often about as long as the joint, and with one or a few wreaths of long, stiff secondary bristles at the middle and very fine, short hairs distally. Postero-distally this joint has two groups of bristles, one situated somewhat proximally of the other. Both groups consist of three moderately long and moderately strong bristles, about subequal and furnished with short hairs; those in the distal group are somewhat shorter than those in the proximal group. The end joint has seven bristles. In all the species investigated by me these were developed in about the following way: The two middle ones were developed as long, powerful and somewhat curved claws, the lateral one of which — which is somewhat longer than the other — is often as long as the second endopodite joint. Of the two anterior bristles one is rather powerful, almost as strong as the middle claws but rather considerably shorter than these, the other is weak and in most cases somewhat shorter than the first-mentioned one. The three posterior bristles are all weak and of somewhat different lengths, the longest one somewhat shorter than

the shorter of the two middle claws, the shortest one only a third or a quarter of the length of the previous one. The powerful claws of the end joint are bare, the weaker bristles of this joint are often finely pectinated.

M a l e: — This differs from that of the female especially by the reduction of the masticatory parts. It has formerly always been stated in the literature that the coxale is entirely without any endite. (At any rate I have found no statement that this endite exists, unless the following one by G. O. SARS, 1865, p. 107 can be conceived to refer to this process: „Pedum mandibularium pars basilaris intus tuberculo modo minimo pilis 2 brevibus obsito ut rudimento partis incisivae mandibularium instructa." In his work of 1887 G. O. SARS does not mention any difference with regard to this endite in the males and females of this genus. This statement of G. O. SARS' is repeated without any alteration by G. S. BRADY and A. M. NORMAN in their work of 1896, and it is also found in some other treatises. W. LILLJEBORG, 1853, G. W. MÜLLER, 1890 and 1894 as well as several other writers definitely state that there is no endite on this joint.) On the single male of this genus that I had an opportunity of investigating, the male of *Ph. (Ph.) globosa*, this process is, however, developed, but it is extremely reduced and probably without any function (see fig. 13 of the species mentioned). The medial bristles on the proximal half of the second protopodite joint are developed to the same number as in the females, but are very weak. Other bristles too show some, though only a very slight, difference from those of the females.

M a x i l l a: — This shows strong sexual dimorphism.

F e m a l e: — P r o t o p o d i t e: The basale in rather large and well defined from the first endopodite joint. The three powerful endites are always immoveably joined to the protopodite; the third of them is rather pointed distally. All the species investigated by me showed a rather close resemblance with regard to the bristles on these processes. (Because of this I have not considered it necessary to reproduce them for more than one species, *Ph. (Sc.) Appellöfi*; a detailed description of them is given under the first species, *Ph. (Ph.) globosa*.) The first endite in the forms investigated by me has ten to twelve distal bristles, the second has six, the third has nine or ten. Proximally on the outside of the third endite there is a single bristle. Dorsodistally on the coxale there is a single bristle with soft, long hairs. On the boundary between the protopodite and the endopodite there are some bristles: one close to the exopodite, one at about the middle of the inside of the palp and one or more on the anterior edge of the palp. This genus seems to be without any e p i p o d i a l a p p e n d a g e. G. W. MÜLLER writes with regard to this appendage in this genus, 1894, p. 56: „bei *Philomedes* habe ich an seiner Stelle nur einen flachen, fein behaarten Hautsaum entdecken können". In the species investigated by me the place at which in the sub-family *Cypridininae* the epipodial appendage issues had also a „Hautsaum" with fine, soft hairs situated close together. E x o p o d i t e: This is small and short, almost verruciform and naked and situated on the boundary between the protopodite and the endopodite. E n d o p o d i t e: First joint: Anteriorly near the distal boundary this joint has, in all the forms investigated by me, one bristle, posteriorly-distally there are on this joint a somewhat greater number (4—5 were observed). These bristles are of moderate length and strength, decreasing somewhat in length the more anteriorly

they are situated. This joint has not the distal-posterior cutting edge that is characteristic of most genera of the sub-family *Cypridininae.* The little end joint is moderately strongly chitinized and is furnished with a rather large number of bristles (see fig. 14 of *Ph. (Ph.) globosa*). With regard to these bristles the species investigated by me showed only slight variation. One group, consisting of three to five bristles in the species investigated by me, forms a transverse row somewhat posteriorly on the outside of the joint; these bristles are of moderate length and strength and decrease somewhat in length the more anteriorly they are situated. The other bristles are situated more or less distinctly along the distal edge of the joint and are rather different in length and strength. One group of these is situated distally inside the other bristles; on the species investigated by me this group, like the former one, numbers from three to five bristles; these are comparatively weak, the posterior ones are moderately long, the anterior ones in most cases rather considerably shorter. Besides these bristles I observed on the species investigated by me five more bristles (only on one specimen of *Ph. (Ph.) Lilljeborgi* were six observed on the maxilla of one side). The three middle ones of these are very powerful and of moderate length, the anterior one being somewhat shorter than the two others, and weakly curved. The bristle that is situated in front of these three is somewhat weaker and in most cases somewhat shorter than the anterior of them and is moderately strongly pectinated. The bristle situated behind these three is in most cases somewhat shorter than the posterior one of them, of moderate strength and moderately strongly pectinated. Pilosity: The first endopodite joint has along its anterior side rather numerous transverse rows of short fine hairs. (The e n d o-p o d i t e and the e x o p o d i t e are so similar in appearance within this genus that it did not seem necessary to me to reproduce them for more than one species: *Ph. (Sel.) Appellöfi*; the end joint is also reproduced for *Ph. (Ph.) globosa.*)

M a l e: — This is of the same fundamental type as that of the female, but it seems certain, however, that it cannot be used as a masticatory organ. It is somewhat smaller than that of the female, and is only weakly jointed; its muscular system is almost completely reduced and all its chitinous parts are soft, thin and hyaline. The bristles seem to be the same or almost the same as on the female maxilla; the bristles that have long secondary bristles in the female maxilla are in the males provided with abundant long, soft hairs along the greater part of their length; similar hairs seem, however, to occur, though more sparsely, also on bristles that have short hairs in the female; distal secondary teeth are quite absent from the bristles. Pilosity: The hairs on the first endopodite joint are more abundantly developed; on the protopodite there is a „Hautsaum" with hairs similar to that found on the female maxilla.

F i f t h l i m b:* — This has marked sexual dimorphism.

F e m a l e: — All the species investigated by me showed a very close agreement with regard to this limb. (Because of this I did not think it necessary to reproduce it for more than one species: *Ph. (Sel.) Appellöfi*; a detailed description is given under the first species, *Ph. (Ph.) globosa.*) P r o t o p o d i t e: In the species investigated by me the first endite constantly has six bristles, of which the four middle ones are situated in a row, the anterior one and the

* In the descriptions this limb is always, for practical reasons, thought of as pointing straight outwards, whereas in the natural position of rest it points obliquely outwards and backwards.

posterior one being placed rather more inward. The second endite in these species has seven to nine, the third eleven to thirteen bristles; some of these bristles are situated very close together, not arranged in a row (in the accompanying figure these endites are rather strongly compressed). Distally on its outer edge the protopodite has no chitinous spine, contrary to most forms of the sub-family *Cypridininae*. The e p i p o d i a l p l a t e has an indication, though only a faint one, of the ear-like shape that is characteristic of the family *Asteropidae*. On its marginal bristles the long hairs continue right out or almost right out to the points; the points of these bristles are not modified to function as sensory organs. This appendage finishes dorsally with an irregular, powerful, spine-like chitinous swelling. The e x o p o d i t e always seems to have four joints. The proximal joint is rather small and weak (cf. fig. 21 of *Ph. (Sel.) Appellöfi*). The main tooth, which is fixed obliquely-transversally, is developed somewhat less strongly than in the sub-family *Cypridininae* and does not seem to play so important a part in breaking up the food as it does in the sub-family mentioned. It seems to be subject to rather slight variation. In all the species investigated by me four constituent teeth were observed; the anterior one of these is longest and most powerful, the others decrease greatly in length and strength the more posteriorly they are situated, the most posterior one often being very small and weak and may even, in very exceptional cases, be quite missing. The constituent teeth are often slightly bent backwards, sometimes almost straight, and are furnished on their posterior edge with irregular teeth which vary in form and number. The anterior, strongest, constituent tooth has proximally on the inside a powerful irregular tooth-shaped protuberance. On all the species of this genus that I investigated there is a single bristle on the posterior side of this joint, close to the main tooth, and three bristles on the anterior side of the joint, two of which are situated close to the main tooth and the third farther out on the joint (cf. fig. 21 of *Ph. (Sel.) Appellöfi*). — These four bristles seem certainly to be homologous with the similarly situated four bristles that were observed in the majority of the forms belonging to the sub-family *Cypridininae* that I have investigated. — The second exopodite joint, on the other hand, is rather large, exceedingly strongly chitinized and differentiated on the inside to a powerful, tooth-like, almost triangular process. This process is weakly bent inwards and backwards, in other words in the same direction as the constituent teeth of the main tooth on the preceding joint. In the species investigated by me this process is furnished on the inner edge near the base with a few rather weak, irregular secondary teeth; on the outside it has a rather powerful, conically rounded, smooth secondary tooth directed obliquely outwards and forwards; apart from this it is quite smooth. This tooth-like joint is certainly the most important masticatory organ of the limb. With the differentiation of the joint itself to the most important masticatory organ a parallel reduction of the bristles on this joint seems to have taken place. In all the species of this genus that were investigated by me only five bristles were observed on this joint; four of these bristles were situated on the posterior side of the large inner tooth-like process, three in one group, the fourth by itself somewhat proximally of the former ones. On account of the position of these bristles in the male it seems probable that the group of three bristles corresponds to the important masticatory bristles in the sub-family *Cypridininae* called the a- and b-bristles, while the single bristle is homologous with the c-bristle in this sub-family.

On the anterior side of this joint, on the powerful and conically rounded secondary tooth that is directed forward, there is a single bristle; judging from the position of this bristle on the male fifth limb it is presumably to be considered as homologous with the d-bristle in the sub-family *Cypridininae.* The two distal exopodite joints in the species investigated by me were rather small, furnished with a number of bristles. It may be pointed out that on all the species in question the inner lobe of the third joint was furnished with three; the outer lobe with two, bristles, thus the same number as is most frequently found in the species belonging to the sub-family *Cypridininae.*

Male: — The epipodial appendage of the protopodite is of about the same size and type and has the same number of marginal bristles as in the female; its muscular system is powerfully developed. The other parts of this limb are also of the same fundamental type as in the female. It is somewhat, though only rather slightly, smaller than that of the female, has a rather weak division into joints, its muscular system is almost entirely reduced and all the chitinous parts are soft, thin and hyaline. The exopodite has four joints as in the female. The two proximal exopodite joints are, as in the sub-family *Cypridininae*, of about equal size. The main tooth of the first joint is represented by four, in exceptional cases by only three, soft, hyaline, irregularly conical processes, with close, soft hairs; these processes are of about the same size as or very slightly smaller than the corresponding constituent teeth in the female. The inner tooth-like process of the second exopodite joint is represented by a process of about the same kind as the one that represents the anterior constituent tooth of the main tooth of the preceding joint. The equipment of bristles on this limb is the same or almost the same as that on this limb of the female. — G. W. Müller states, 1912, however, that there are considerably fewer bristles on this limb in the male than in the female. — All or almost all the bristles have close soft, long hairs at the middle, but they have no secondary teeth distally. Pilosity: The hairs on this limb are more abundantly developed than in the female. — It seems certain that this limb, like the maxilla, cannot be used for mastication.

Sixth limb: — Just as in the case of the maxilla and the fifth limb, all the species of this genus that were investigated by me showed a close resemblance with regard to this limb. (On account of this it did not seem necessary to me to reproduce this for more than one species, *Ph. (Scl.) Appellöfi*; a detailed description is given under the first species, *Ph. (Ph.) globosa.*) It shows weak sexual dimorphism; G. W. Müller states that this limb is similar in males and females. The bristles on the endites of the protopodite and the first exopodite joint, like the anterior bristles on the second exopodite joint are, on an average, somewhat, though in most cases only very slightly, more weakly developed in the males. In the female all or almost all these bristles are furnished at the middle with long, stiff secondary bristles, and are moderately strongly pectinated distally; in the male they have long, soft hairs at the middle and are finely pectinated or even bare distally. The second exopodite joint: This is very much wider than it is long. It has abundant bristles, all situated on or near the ventral edge, sometimes, however, some of them are considerably displaced dorsally on the medial side. The posterior and the anterior of these bristles are not separated from each other by any pronounced gap. The posterior bristles are, on the average, somewhat longer than the

anterior ones and have long, soft hairs, either, as in the case of those situated farthest back, right out to their points, or else only along the greater part of their length; in the last-mentioned case they have short hairs distally. Most or all the anterior bristles have long, stiff secondary bristles at the middle and are moderately strongly or finely pectinated distally. The transition from the anterior to the posterior type of bristle is gradual.

Seventh limb: — This shows weak sexual dimorphism (G. W. MÜLLER states, 1912, p. 25, that this limb is similar in both sexes).

Female: — The number of cleaning bristles varies somewhat, from eight to over forty were observed. Some of these are situated close together distally, the others are placed irregularly along the distal part of the limb; with regard to the position of the latter it is to be noted that it is only exceedingly seldom that there is more than one bristle on the same side of the same joint. The end comb consists of a rather slight or a moderate number of teeth (from about seven to nearly twenty), which, unlike in most forms of the sub-family *Cypridininae*, cannot be divided into proximal and distal teeth. Dorsally near the end comb the wall of the limb becomes somewhat thicker and is furnished with a varying number of chitinous pegs; in addition the wall is somewhat concave here, the depth of the concavity varying. The dorsal and ventral walls of the concavity are not moveably joined to each other, nor is there any special adductor such as is found in many of the forms belonging to the sub-family *Cypridininae*. Whether, in spite of this, the end comb can be pressed in towards the dorsal edge of the concavity I have not been able to decide, as I have had only preserved material of these forms at my disposal. I wish merely to state here that among the material investigated by me I never found any specimen with its end comb pressed inwards, although I had very abundant material.

Male: — Differs from that of the female especially by the cleaning bristles having a somewhat, though only very slightly, smaller number of bells and by a slight reduction of the end comb.

Penis: — This is small, but has a rather well-developed muscular system. Distally it is divided into two rather short, curved processes, both having a few bristles distally (= the exopodite and endopodite of an original biramous limb?). It is rather weakly chitinized and has no strongly thickened lists.

Furca: — This has weak (or is sometimes quite without?) sexual dimorphism. G. W. MÜLLER states, 1912, p. 25, that in this genus this organ is quite alike in males and females.

Female: — The lamellae seem to be subject to rather slight variation with regard to type; they are moderately elongated. From six to fifteen, in most cases from nine to twelve, furcal claws have been observed; the number of claws seems to be subject to some, though only a rather slight, variation in several species of this genus. In a number of species main claws and secondary claws can be distinguished, in others a division of this kind cannot be carried out; all the claws are well defined from the lamella. On all the species of this genus that were investigated by me the equipment of the claws is about as follows: The first claw has two rows of smooth secondary teeth; the inner row, which is displaced somewhat dorsally, consists for the most part of powerful teeth pointing distally, the teeth in the outer row are either powerful or there is an irregular alternation between powerful and weak ones — in this respect

there is variation within the species; like the secondary teeth on the succeeding claws, they are directed obliquely ventrally-distally. On the following three to five claws the medial row of teeth is absent; the lateral row on these is about the same as the corresponding row on the first claw, but the teeth are somewhat weaker the more posteriorly they are situated. These four to six claws are bare or almost bare dorsally; their distal parts are also quite bare. Of the succeeding claws the anterior ones, like the preceding ones, are furnished with a lateral row of rather coarse teeth; distally they are moderately strongly pectinated dorsally and ventrally right to their points; the coarse secondary teeth become more and more rare on these claws the more posteriorly the claws are situated; on the most posterior they are often quite missing; distally the posterior claws are finely pectinated dorsally and ventrally. On the anterior claws there is often a transverse row of long, stiff, smooth bristles proximally-medially. Similar bristles may also be found on the lamellae medially close to the claws. The pilosity of the lamellae varies.

Male: — In this sex the furca is of about the same size as in the female, but it is constructed more weakly. The number of claws is the same or only slightly less than in the female; their equipment is somewhat weaker.

Upper lip: — This shows no sexual dimorphism. — It seems to be subject to only very slight variation within this genus. Because of this I did not think it necessary to reproduce it, but merely refer the reader to G. W. MÜLLER's reproduction, 1908, pl. VI, fig. 15. It is rather small and somewhat helmet-shaped, with an unpaired conical median process, pointing somewhat upward and forward; on the point of this process there is a small glandular field. Between the lip and the frontal organ there are some irregular protuberances.

The median eye is well developed in both sexes (it is less pigmented in the female than in the male). The rod-shaped organ is also similarly developed in the two sexes; it is long and narrow and grows slightly narrower distally.

Lateral eyes: — These are reduced in the female, being only represented by a little claviform unpigmented process on each side, in the distal part of which there are remains of the crystalline cones of a few ommatids. (Sometimes quite disappeared?). In the males, on the other hand, the lateral eyes are very well developed and situated rather far towards the back.

There are never any gills.

Special terminology: — First antenna: — The far-reaching agreement that I have stated between the position of the bristles on the original seventh and eighth joints in this genus and the position of the bristles on the corresponding joints in the subfamily *Cypridininae* can scarcely be explained in any other way except by an assumption that these bristles are really homologous. Because of this I considered that I was justified in using the same alphabetical notation for these bristles in this genus as was used above for the subfamily just mentioned. Of the bristles on the original seventh joint the anterior one is accordingly called the a-bristle, the medial one the b-bristle and the two posterior bristles the c_1 and c_2 bristles. Of the bristles on the original eighth joint the two that are situated close to each other laterally are called the d- and e-bristles (the anterior one the d-bristle and the posterior one the e-bristle), the anterior-medial one the f-bristle and the postero-medial one the g-bristle.

M a x i l l a: — End joint: The bristles of this joint, as will be seen from what has been said above, also show an exceedingly close agreement with regard to their position with the bristles of the corresponding joint in the sub-family *Cypridininae*. On account of this there can scarcely be any doubt that there is real homology present. In this case too I have thought myself justified in using a similar alphabetical notation, based on homologization, for these bristles as for those of the sub-family just mentioned. The group whose (three to five) bristles form a transverse row on the outside of this joint are consequently denoted as a-bristles, the group (two) distally-anteriorly = b-bristles, the group (three to five) distally-medially = c-bristles and the remaining bristles, situated postero-distally on this joint = d-bristles.

F i f t h l i m b: — With regard to the homologization of the bristles on the second exopodite joint I merely refer to what has been written above in the description.

[illegible]

Remarks: — The five species of this genus that have been described in this work certainly form quite a natural classificatory unit.

One of these forms, *Ph. Appellöfi*, is, however, opposed to the others in some characters, especially by its strongly marked shell sculpture and its jointed rod-shaped organ. On account of this it seemed convenient to distinguish this species as a representative of a new sub-genus, which has been given the name of *Scleroconcha*.

Of the species of this genus dealt with in the literature it is rather certain that three others belong to this sub-genus, viz.:

Ph. Folini, G. S. BRADY, 1871, p. 294, pl. XXVII, figs. 1—5.
,, *sculpta**, ,, ,, ,, 1898, p. 434, pl. XLIV, figs. 15—20.
,, *flexilis*, ,, ,, ,, 1898, p. 435, pl. XLIV, figs. 1—14, pl. XLV, figs. 15, 16.

All these three forms are characterized by a very powerful shell sculpture, developed in the form of extensive ridges. At least two of them, *Ph. Folini* and *Ph. flexilis*, have, in addition, a jointed rod-shaped organ of the same type as *Ph. (Scl.) Appellöfi*. In *Ph. sculpta*, unfortunately, this organ is unknown. — It does not seem impossible that another species, *Ph. Wyville-Thomsoni*, G. S. BRADY, 1880, p. 160, pl. XXXVI, fig. 1, a—c, is to be referred to *Scleroconcha* too. Because of the incomplete description — this species is referred by G. W. MÜLLER, 1912, to ,,Cypridinidarum genera dubia et species dubiae" — nothing, however, can be said with certainty about it.

With regard to the mutual relations of the other species referred to this genus it is still too early to make any definitive statement; the descriptions are generally, unfortunately, too incomplete. It will probably be necessary — even after distinguishing *Pleoschisma* and *Tetragonodon* as special classificatory units, cf. p. 348 above — to carry out a further division; I need only point out here that such aberrant forms as *Ph. longiseta* CH. JUDAY and *Ph. lomae* CH. JUDAY certainly cannot be retained in this genus.

Detailed diagnoses of the two following sub-genera may conveniently be postponed until a greater number of species of this genus have been subjected to a closer re-examination.

* This species is, hesitatingly, identified by G. S. BRADY himself, 1898, p. 435 as *Streptoleberis crenulata*, G. S. BRADY, 1890, p. 515. This identification demands too much, however, from the inexactitude of the two descriptions to be adopted a priori. Of course its correctness is not absolutely impossible!! — It does not seem to me impossible that *Ph. sculpta* and *Ph. flexilis* are male and female of the same species.

Sub-genus Philomedes W. Lilljeborg.

Philomedes (p a r t.), a u t o r u m.

Diagnosis: — See above, p. 380.

Remark: — As to the number of species of this unit, see above, pp. 348 and 380. Sub-genotype is *Ph. (Ph.) globosa* (Lillj.).

Ph. (Philomedes) globosa W. Lilljeborg.

Cypridina globosa, W. Lilljeborg, 1853, p. 171, pl. XVII, figs. 2—10, pl. XVIII, figs. 1—3, 7.
Philomedes longicornis, W. Lilljeborg, 1853, p. 176, pl. XXVI, figs. 4—6, 14—16.
Asterope groenlandica, S. Fischer, 1855, p. 26, pl. XX, figs. 26—34.
Philomedes longicornis, W. Baird, 1860 a, p. 202, pl. LXXI, fig. 5.
Cypridina globosa, G. O. Sars, 1863, p. 60.
Philomedes longicornis, G. O. Sars, 1865, p. 107.
Bradycinetus globosus, G. O. Sars, 1865, p. 110.
,, *brenda*, G. S. Brady, 1868 a, p. 128.
.. .. ,, ,, ,, 1868 b, p. 466.
Philomedes globosus, G. O. Sars, 1869, p. 355.
,, *brenda*, ,, ,, ,, 1872, p. 280.
Bradycinetus ,, G. S. Brady and D. Robertson, 1872, p. 70.
Philomedes globosus, W. Lilljeborg, 1876, p. 3.
Bradycinetus brenda, G. S. Brady and D. Robertson, 1876, p. 187.
Philomedes ,, G. O. Sars, 1886, p. 74.
.. *globosus*, H. J. Hansen, 1887, p. 255.
.. *brenda*, A. M. Norman, 1891, p. 119, 121.
.. .. G. S. Brady and A. M. Norman, 1896, p. 654, pl. LI, figs. 1—3, pl. LVI, figs. 1—3.
,, *globosus*, C. W. S. Aurivillius, 1896, p. 211.
,, *brenda*, E. Vanhöffen, 1897, p. 285, pl. I., fig. 3.
.. *globosus*, C. W. S. Aurivillius, 1898, p. 398, 400.
.. *brenda*, G. W. Müller, 1898, p. 40, figs. 1—3.
.. .. Th. Scott, 1899, p. 89.
.. .. G. W. Müller, 1901, p. 10, figs. 18, 19.
.. .. G. S. Brady, 1902 b, p. 99.
.. .. Th. Scott, 1905, p. 228.
,, .. O. Nordgaard, 1905, p. 40.

Philomedes brenda C. H. OSTENFELD, 1906, p. 97.
„ „ A. K. LINKO, 1907, p. 195.
„ „ C. H. OSTENFELD and C. WESENBERG-LUND, 1909, p. 114.
„ „ A. M. NORMAN and G. S. BRADY, 1909, p. 359.
„ „ G. O. SARS, 1909, p. 40.
„ „ C. APSTEIN, 1911, p. 168, Pl. XXIII.
„ „ G. W. MÜLLER, 1912, p. 32.
„ *globosus*. K. STEPHENSEN, 1912, p. 551.
„ *brenda*. „ „ 1913, p. 353.
„ „ „ „ 1917, p. 306.

Description: — Female: —

Shell: — Length 2.3—3.1 mm.; only specimens from the most northern locales, Greenland, Spitzbergen etc. have shells as long as 2.9—3.1 mm.; the specimens from the more southern locales are, on the average, rather considerably shorter; thus, for instance, the specimens from Skager Rak that were investigated by me were, on an average, only about 2,4—2,6 mm. Length : height, about 1.4 : 1; length : breadth about 1.75 : 1. Seen from the side, (fig. 3) it has a somewhat varying shape, though the variation is rather slight. The greatest height is at about the middle. The dorsal margin is rather weakly arched; this arching is, however, somewhat different in different individuals; it is somewhat sloping posteriorly and with broadly rounded corners passes over into the rather steeply sloping anterior and posterior margins. The ventral margin is uniformly and moderately strongly curved and is somewhat pouting just behind the incisur. The posterior part of the shell forms a rather slightly projecting and somewhat rounded corner somewhat ventrally of half the height of the shell; above this corner the posterior margin of the shell is straight or is only slightly arcuated. The rostrum has a more or less rounded anterior corner, projecting in most cases almost at a right angle; its ventral corner is rather pointed and has a small spine-like process. The rostral incisur is rather deep and narrow and is defined from the ventral margin by a weak protuberance. Seen from below the shell is oval, with its greatest breadth at about the middle, the anterior and posterior ends of about the same shape, the side contours almost uniformly curved (about the same as in the accompanying figure 2 of the male). The surface of the shell has no marked protuberances except one weak ridge behind the rostral incisur, continuing on to the above-mentioned small protuberance that forms a boundary between the ventral margin of the shell and the incisur, and the small spine on the point of the rostrum. It is covered with numerous rounded cavities, situated fairly close together; these are very often difficult to discern, especially on the specimens from the more southerly locales, and sometimes they even seem to be quite absent. The whole surface has scattered short, stiff bristles, situated rather close together; among these there are also a few somewhat longer bristles, distinguished by the fact that from a short rather thick basal part they taper to a fine point (these bristles are, however, not quite so long as those on the shell of the males), see fig. 4. The pores of the surface are very difficult to discern with certainty in most cases; they are rather small and numerous. Seen from inside: Medial

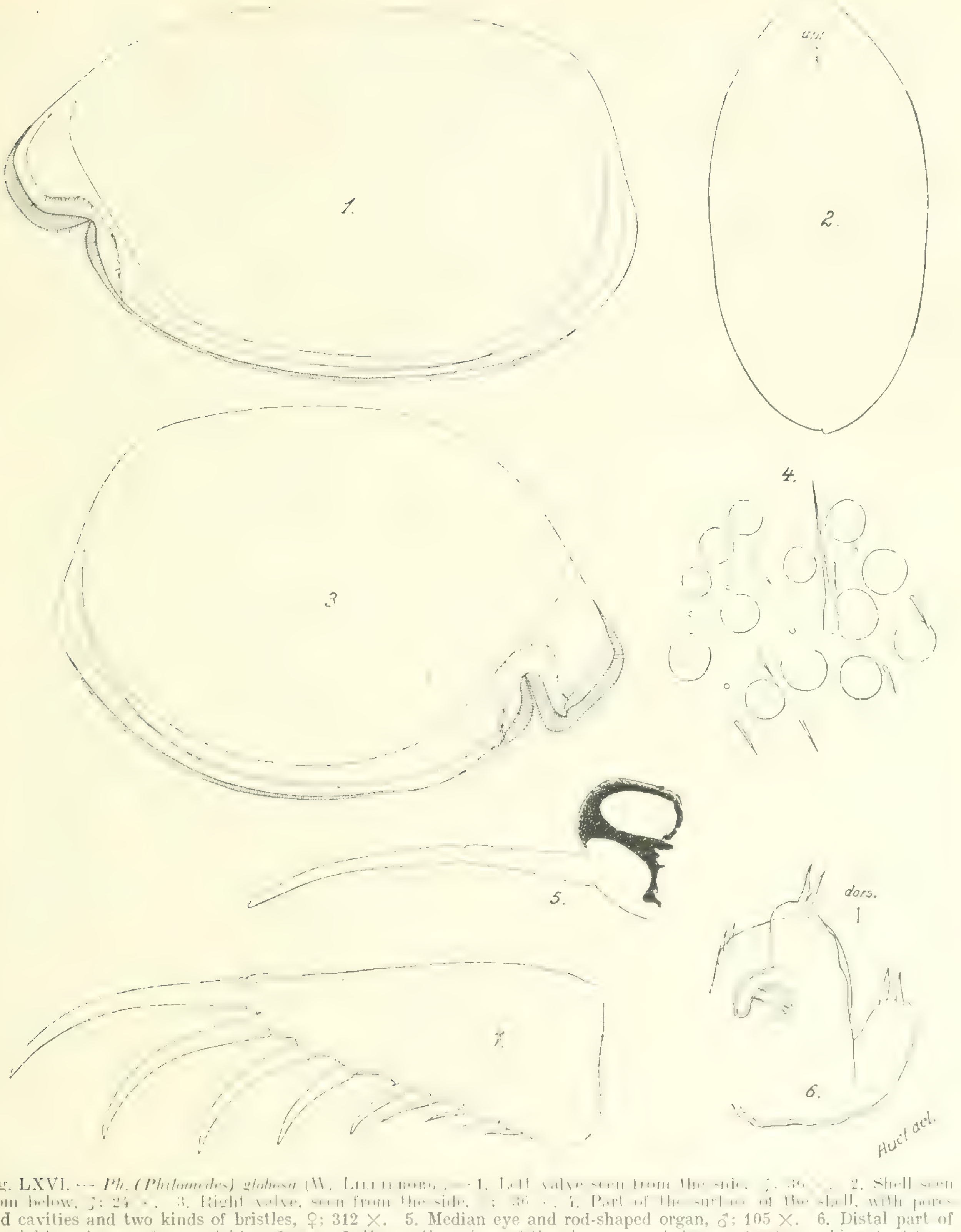

Fig. LXVI. — *Ph. (Philomedes) globosa* (W. Lilljeborg). — 1. Left valve seen from the side, ♂; 36 ×. 2. Shell seen from below, ♂; 24 ×. 3. Right valve, seen from the side, ♂; 36 ×. 4. Part of the surface of the shell, with pores and cavities and two kinds of bristles, ♀; 312 ×. 5. Median eye and rod-shaped organ, ♂; 105 ×. 6. Distal part of the right penis, seen from outside; 272 ×. 7. Furca; the spines of the claws are not drawn, ♂; 84 ×. Figs. 1–4 from specimen from Greenland, 5–7 from specimens from Skager Rak.

bristles: The row of bristles on the rostrum has rather numerous bristles (about the same as shown in fig. 2 of *Ph. (Ph.) Lilljeborgi*). On the posterior part of the list there is a moderate number of bristles, partly arranged in groups. Between the list and the posterior margin of the shell there is a rather small number of short bristles (about the same as shown in fig. 3 of *Ph. (Ph.) Lilljeborgi*). The marginal hairs on the rostral selvage are rather long. The long secondary bristles on the selvage behind the incisur, issuing from inside the margin of the selvage, are very few in number; they sometimes seem to be entirely absent. Between the list and the posterior margin of the shell there is no pocket-like formation as in *Ph. (Ph.) Lilljeborgi*. Colour: According to C. APSTEIN, 1911, it is a beautiful red; the preserved specimens are a whitish yellow.

First antenna: — Of the three bristles on the second joint the anterior one is about as long as the anterior side of the third joint or the third plus the fourth joints, the posterior one about as long as the total length of the third and fourth or the third to the fifth joints, the lateral one is in most cases slightly shorter than the posterior one. The third joint has most frequently two anterior bristles and one posterior bristle distally. Of the two anterior ones the posterior one is often about as long as the total length of the third and fourth joints, the other is only about half this length. The posterior one is, in most cases, about as long as the fourth joint. In some cases three anterior distal bristles are found on this joint, either on both antennae or only on one. The fourth joint has one anterior bristle, which is about twice the length of the fifth joint, and four posterior bristles. Of the latter the two lateral ones are about as long as the posterior side of the second to the fourth joints, the one nearest to them is about as long as or a little longer than the anterior bristle on this joint, the remaining one, the inner one, is only about half as long. The bristle of the fifth joint is about as long as the last-mentioned bristle. The a-bristle on the end joint is about as long as the anterior bristle of the fourth joint. Either all these bristles are equipped at the middle with one or a few irregular wreaths of long, stiff secondary bristles or else some of them may be without such wreaths; the following bristles were sometimes found to have no wreaths of bristles: the shorter of the two anterior bristles on the third joint and one of the long ones of the four posterior bristles on the fourth joint; the wreaths on these bristles vary both from one individual to another and on the right and left antennae of the same individual. As is seen from what has been said above, the length of these bristles varies somewhat; the variation is, however, rather slight. End joint: The b-bristle has one sensorial filament somewhat proximally of half its length and three distal sensorial filaments; in one case two proximal sensorial filaments were found on this bristle on the first antenna of one side, the other first antenna had only one, as usual. The two c-bristles have in most cases five proximal and four distal sensorial filaments; in one case (on both the first antennae) five proximal sensorial filaments were found on one of these bristles and six on the other; in another specimen (similarly on both the first antennae) six proximal sensorial filaments were found on both these bristles; finally in a third case five proximal sensorial filaments were discovered on one of these bristles on both first antennae, on the other six on one antenna, seven on the other. The f-bristle has four proximal and four distal sensorial filaments; only in one case were six proximal sensorial filaments found on this bristle on the first antenna of one side. The g-bristle always has three proximal and four distal sensorial filaments. The position of these

sensorial filaments is quite the same as is shown in fig. 8 of *Ph. (Ph.) Lilljeborgi.* Pilosity: The second joint has rather abundant transverse rows of short, stiff hairs. (This limb agrees entirely with that of *Ph. (Ph.) rotunda*; cf. the figure 3 for this species).

Second antenna: — Exopodite: The first joint is rather short, being only about as long as the total length of the following joints. The bristles on the second to the fifth joints are about as long as the first joint or even as the total length of the three proximal joints; they are bare and have a simple point distally. The proportion between the length of the long natatory bristles and the exopodite is about eight to five. The end joint has seven bristles, the three dorso-medial of which are short; of these three the longest one is about as long as the first or the first three joints, the shortest is only about as long as the total length of the three to the five distal joints; the shortest one often has short hairs, the two others are usually equipped with rather sparse long natatory hairs. In females with their embryos far developed the long natatory bristles are broken off; after this they are of about the same length as the bristles on the second to the fifth joints or are even still shorter. The second to the eighth joints have rather short and weak basal spines, smallest on the proximal joints and sometimes apparently even quite absent on the second joint. In most cases the basal spines are simple; sometimes, however, they have two or three points. Sometimes one or more smaller spines can be observed close to one or more of the basal spines; these small spines (presumably like the basal spines) are obviously only strengthened separate hairs in the rows of hairs that are found distally on these joints. Endopodite: The first joint has six bristles, with short hairs or almost bare, moderately long and strong; five of these are situated in one group, the sixth is situated somewhat distally of the others. The second joint varies somewhat in shape, but has in most cases the shape reproduced in fig. 12. Ventrally this joint has usually only one bristle, situated somewhat proximally of the middle of the joint. This bristle is rather long, but its length varies somewhat; it is furnished at the middle with several irregular wreaths of long, stiff secondary bristles and has short, fine hairs distally. On one specimen this endopodite had, both on the right and the left antenna, an additional bristle distally of the former one; this bristle had the same type as the former one, but was not quite half as long as it. On another specimen a bristle of this sort was observed on the antenna of one side, the one of the other side having only a long one. Finally in one specimen this joint had ventrally two bristles of about equal and moderate length; both of these had a few irregular wreaths of long, stiff secondary bristles at the middle and short hairs distally. The distal bristle of this branch is about as long as the second joint, sometimes, however, a little shorter, sometimes a little longer; distally it is finely rounded. In one specimen, both on the right and the left antenna, a proximal protuberance was observed on this bristle; this protuberance was of about the same type as that which G. W. Müller observed in *Ph. (Ph.) levis* (1894, pl. 3, fig. 31).

Mandible: — Protopodite: The basale has from six to eight moderately long bristles ventrally, most of them subequal; one or more of those situated most distally are slightly longer than the others. Dorsally this joint has, in addition to the two distal bristles, two other bristles, one situated somewhat in front of the other just in front of the middle of the joint. One of the distal bristles is about as long as the anterior side of the first endopodite

joint, the other is about twice as long as this. The two others of the bristles mentioned are subequal and about as long as the shorter distal bristle. All four are of about the same type, with a wreath of long, stiff secondary bristles at the middle and exceedingly fine, short hairs distally. Exopodite: The distal bristle is most frequently about the same length as this branch, the other is rather slightly shorter; either they both have a wreath of long, stiff secondary bristles at the middle and exceedingly fine, short hairs distally or else one of them has no wreath of bristles. Endopodite: First joint: Three of the four ventral bristles are long and have a few wreaths of long, stiff secondary bristles at the middle and fine, short hairs distally; the fourth is usually only about a third of the length of these three and has one wreath of long secondary bristles at the middle and short, fine hairs distally. (The proportions of these bristles are about the same as in fig. 11 of *Ph. (Ph.) Lilljeborgi*). Second joint: The proximal group of bristles on the anterior side most frequently number three, sometimes four; these are somewhat different in length, the longest being from a third to a half the length of the anterior side of this joint; they all usually have exceedingly fine, short hairs; sometimes, however, some of them may have some long secondary bristles at the middle. Between this group of bristles and the distal anterior group there is on the medial side one bristle (on one mandible of one specimen two bristles) of the same length as the bristles in the proximal group, but with somewhat coarser short hairs (about the same as in fig. 11 of *Ph. (Ph.) Lilljeborgi*). End joint: The longest middle claw is about as long as the second endopodite joint; the anterior claw is scarcely half this length. Pilosity: The second protopodite joint and the second endopodite joint have groups of short, stiff hairs on the inside.

Maxilla: — Protopodite: First endite: This has ten bristles distally. The two inner ones of these are subequal, of moderate length and strength, furnished at the middle with one or two oblique wreaths of long, stiff secondary bristles and fairly strongly pectinated distally. Four bristles of about the same strength and length as the preceding ones — their length and strength varies, however, to some extent — usually have one, sometimes two, wreaths of long, stiff secondary bristles at the middle, and rather powerful secondary teeth, often rather few in number, distally; the number of these secondary teeth varies, however, rather greatly. Three of them, one situated just outside the two first-mentioned ones, one at the outside of all the other bristles of this process and one about half-way between the two others, are somewhat shorter and weaker than the six already described; they usually have a wreath of long, stiff secondary bristles at the middle and are rather strongly pectinated distally; sometimes their distal secondary bristles are also rather long. The remaining bristle is situated almost opposite the middle one of the three bristles just mentioned and is very short and rather weak; sometimes it has short hairs and sometimes a wreath of long, stiff secondary bristles at the middle (see fig. 12 of *Ph. (Scl.) Appellöfi*). Second endite: This has six distal bristles of moderate length; sometimes all these are subequal, often one of the anterior or the posterior ones is somewhat shorter than the others. The two middle ones are powerful, considerably more so than the others, and are furnished distally with a somewhat varying number of strong secondary teeth; the four others with a moderately strong pectination distally. All six usually have a wreath of long, stiff secondary bristles at the middle (see fig. 13 of *Ph. (Scl.) Appellöfi*).

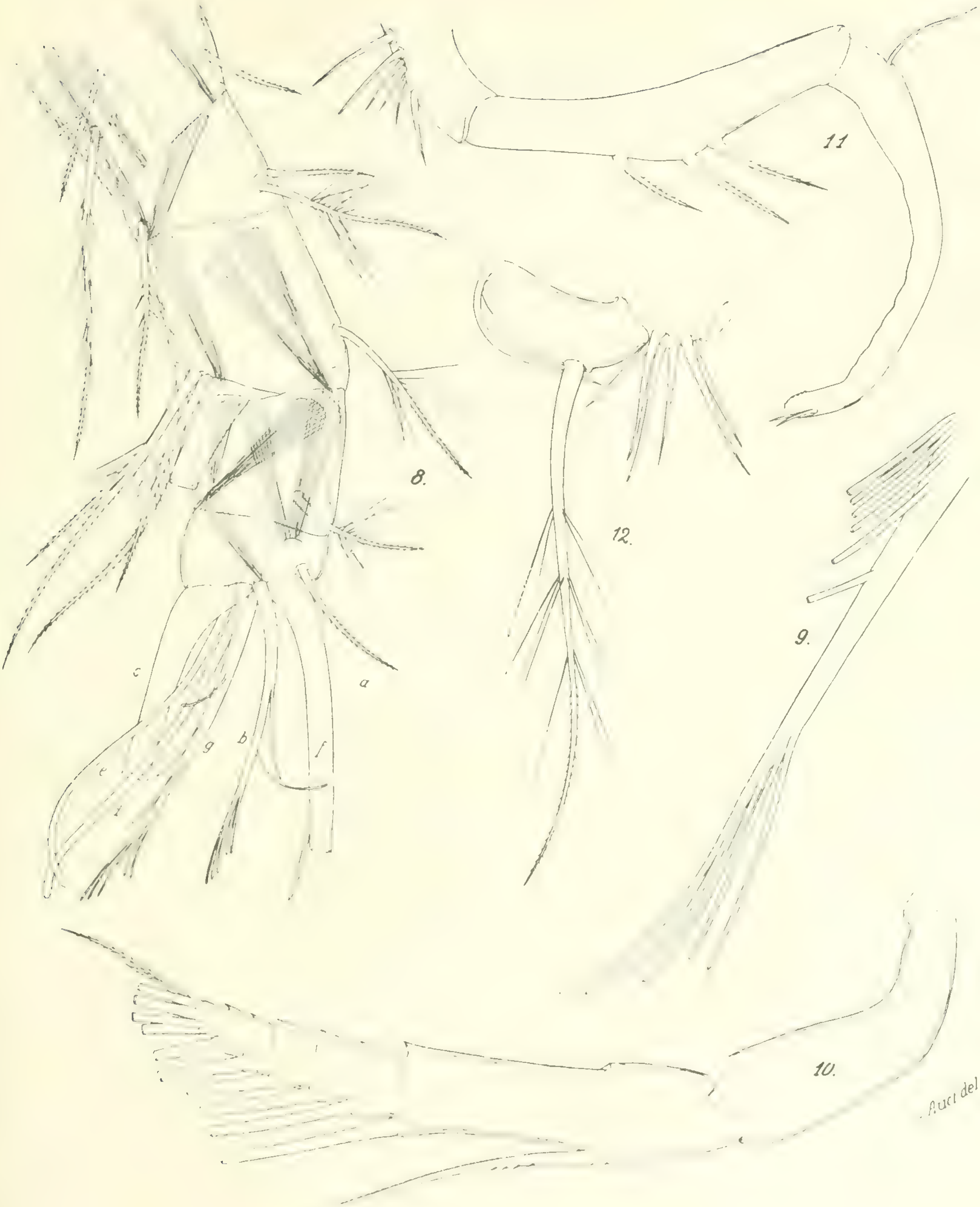

Fig. LXVII. — *Ph. (Philomedes) globosa* (W. Lilljeborg). — 8. Distal part of the left first antenna, seen from inside; the c- and f-bristles are broken, ♂; 160 ×. 9. Distal half of the sensorial bristle of the fifth joint of this antenna; the proximal filaments are broken, ♂; 408 ×. 10. Exopodite of the right second antenna, seen from outside; the bristles of the 3rd—8th and 4 of the bristles of the 9th joint are broken, ♂; 105 ×. 11. Endopodite of the right second antenna, ♂; 160 ×. 12. Endopodite of the left second antenna, ♀; 312 ×. From specimens from Skager Rak.

The third endite has nine or ten bristles distally. Of these nos. 1, 2, 3, 4 and 9, counting from outside, are of about the same type, subequal, moderately long and strong, with a wreath of long, stiff secondary bristles at the middle and rather finely pectinated distally; on bristle no. 3, which is somewhat more powerful than the others, the pectination is also somewhat stronger. Bristles nos. 5 and 8 are of about the same length as the former ones, but rather considerably more powerful, furnished distally with a varying number of powerful secondary teeth and a number of weak ones; these two bristles are quite without long secondary bristles. Between these two bristles there is a bristle of the same type but in most cases rather considerably shorter. The remaining bristle or, in the case of ten bristles (which seems to be the more usual), the two remaining ones are in most cases somewhat longer than the others, are rather finely pectinated distally and usually have two wreaths of long, stiff secondary bristles at the middle (see fig. 14 of *Ph. (Sel.) Appellofi*). The bristle situated proximally on the outside of this process has long hairs or is almost bare; it is of about the same length and strength as the outer distal bristles on this process. The dorso-distal bristle on the protopodite is of about the same length as the last-mentioned bristle. On the boundary between the protopodite and the endopodite there are three bristles: one close to the exopodite, one at the middle of the inside of the palp and one on the anterior side of the palp. The first of these is about as long as the endopodite and is usually furnished at the middle with two wreaths of long, stiff secondary bristles and with short hairs distally. Of the two others the one on the inside of the palp is of the same type as the former one, but somewhat longer, and is in most cases furnished with three wreaths of bristles; the bristle on the anterior edge is about as long as the first endopodite joint and has in most cases a collection of long, stiff secondary bristles at the middle and short hairs distally. E x o p o d i t e: Of the three bristles two are usually long, subequal or somewhat different in length, and about as long as the endopodite, in most cases furnished with some irregular wreaths of long, stiff secondary bristles at the middle and with short hairs distally. The third is considerably shorter, often only about half the length of the former ones, often furnished with some long secondary bristles at the middle and short hairs distally; on one specimen this bristle was about as long as the two other bristles. The long secondary bristles on these three bristles seem to vary a good deal. E n d o p o d i t e: First joint: The bristle situated distally on the anterior side is not quite as long as this joint; in most cases it has one or two wreaths of long, stiff secondary bristles at the middle and short hairs distally. Distally-posteriorly this joint has five bristles, with short hairs or almost bare. End joint (fig. 14): This has four bare or almost bare a-bristles, four or five, in most cases five, c-bristles with short hairs. The three strong bristles among the b- and d-bristles are fairly strongly or else weakly pectinated at the middle. Pilosity: The third endite has soft hairs situated close together on the outside; the first endopodite joint has, especially on the anterior side, numerous transverse groups of short, fine hairs.

F i f t h l i m b: — P r o t o p o d i t e: First endite: Of the six bristles the four middle ones are subequal, moderately long and strong; the anterior one and the posterior one are considerably shorter and weaker, in most cases less than half the length of the four others. All these bristles have one or two oblique wreaths of long, stiff secondary bristles; bristle no. 2, counting from the anterior side of the limb, is rather strongly pectinated distally; on bristle

no. 3 the long secondary bristles continue almost to the point of the bristle; nos. 4 and 5 are in most cases furnished distally with a comparatively few powerful secondary teeth; the short anterior and posterior bristles are sometimes bare distally, sometimes rather strongly pectinated (see fig. 17 of *Ph. (Scl.) Appellöfi*). The second endite has nine bristles, in exceptional cases only eight. They are subequal and of moderate length and strength; they are either all furnished at the middle with long, stiff secondary bristles or else one or two may be without these; most of them are rather strongly pectinated distally; on a few the pectination is comparatively weak (see fig. 18, *Ph. (Scl.) Appellöfi*). The third endite has thirteen bristles, of moderate length and strength; the anterior bristle seems to be always a little shorter and weaker than the bristle situated nearest to it; the others decrease on the whole somewhat in length the more posteriorly they are situated. On some bristles there is a wreath of long, stiff secondary bristles at the middle, but most of them have no such bristles; all the bristles are pectinated distally, some rather finely, most rather strongly (see fig. 19 of *Ph. (Scl.) Appellöfi*). The epipodial appendage has about fifty to sixty marginal bristles. Exopodite: First joint: The main tooth consists of four constituent teeth of about the same type as that reproduced for *Ph. (Ph.) Lilljeborgi*, i. e. with a very coarse and clumsy anterior tooth. The short posterior constituent tooth is often very weak; on one specimen it was even missing altogether on the limb of one side; in exceptional cases this tooth has no secondary teeth at all. On the inside of the anterior constituent tooth there is a coarse, clumsy, smooth, often somewhat bifurcated, tooth-like protuberance. The bristle near the main tooth on the posterior side of this joint is about as long as the anterior constituent tooth, is rather powerful and is fairly strongly pectinated distally; it has no long secondary bristles. Of the three bristles on the anterior side of this joint the two situated near the main tooth are subequal, somewhat longer but weaker than the bristle on the posterior side of the joint; these two bristles are finely pectinated distally; the outer one has a wreath of long, stiff secondary bristles at the middle. The third of these bristles, the one situated farther out on the joint, is rather short and is furnished with moderately long hairs. Close to this bristle there is a group of short, stiff hairs. Second joint: The middle bristle in the group of three and the bristle situated by itself, the c-bristle, are subequal and of moderate length and strength; the two remaining ones in the group of three are subequal, considerably shorter and weaker, being in most cases not half as long as the two preceding ones. All these four bristles are often bare or almost bare; in some cases the c-bristle may have sparse, long secondary bristles at the middle. The bristle on the anterior side of this joint, on the anteriorly pointing tooth, is short, weak, bare or almost so; it is in exceptional cases missing (pulled off in such cases?). The two distal exopodite joints are weakly developed; the outer lobe of the third joint especially is almost completely reduced. Third joint: The inner lobe has three bristles distally, all of moderate length and strength. One of these is somewhat more powerful than the others and is furnished distally with a number of moderately strong secondary teeth. The second is moderately strongly pectinated distally and has a varying number of long, stiff secondary bristles at the middle. The third is somewhat shorter and weaker than the others and is bare or is only sparsely furnished with short secondary bristles. Variation was observed in the relative length and strength of these bristles, but it was rather slight. The

outer lobe has two subequal bristles of moderate length and strength, sometimes furnished with some wreaths of long, stiff secondary bristles, sometimes with dense, long, soft hairs along the greater part of their length, and with short hairs distally. The end joint is moderately large and has in most cases six, sometimes seven, bristles distally. These are somewhat different in length and all moderately long and strong; at the middle they have one or more wreaths of long, stiff secondary bristles, distally they are finely pectinated. Variation was observed with regard to the length and equipment of the bristles, but this was rather slight. The end joint of the exopodite is partly furnished with soft hairs, especially on the outside.

Sixth limb: — Protopodite: The first endite has two rather short medial bristles and one moderately long and strong distal bristle; the medial bristles have soft hairs, the distal bristle has two or three wreaths of long, stiff secondary bristles placed obliquely, continuing in most cases right to the point of the bristle. The second endite has one medial bristle and three, exceptionally four, distal bristles. The third endite has one medial bristle and seven to nine distal bristles. The endite on the first exopodite joint has one, rarely two, medial bristles and seven to nine distal bristles. The medial bristles on the three last-mentioned endites are moderately long, in most cases with long, soft hairs at the middle or sometimes with rather stiff, long secondary bristles; distally they are bare or finely pectinated. The distal bristles on these processes are of slightly different types, subequal or differing rather slightly in length, moderately long and strong; all or almost all of them are furnished at the middle with long, stiff secondary bristles and have moderately strong pectination distally. The length, strength and equipment of these bristles are subject to some, though only rather slight, variation. The epipodial appendage of the protopodite is represented by four, very rarely three or five, short bristles with soft long hairs. The second joint of the exopodite is about twice as broad as it is long; distally it has twenty to thirty bristles differing somewhat in length. This joint has fine, short hairs both on the medial and on the lateral side; hairs may also be observed on the protopodite.

Seventh limb (fig. 16): — This is of moderate length, being a little more than half the length of the shell (in some specimens with shells about 3 mm. long this appendage was from 1.7 to 1.9 mm. long). Cleaning bristles: Situated close together distally there are from six to nine dorsal and four to five ventral bristles; proximally of these there are from nine to thirteen dorsal and seven to twelve ventral bristles scattered irregularly. These bristles are of moderate and of somewhat different lengths, varying somewhat both from individual to individual and on the right and left limbs of the same individual. They are furnished with from three to nine bells cut off transversally distally; the tongue of the distal bell is also cut off rather transversally; proximally to the bells there are scattered irregularly on the cleaning bristles a moderate or rather small number of rather weak secondary spines. The end comb consists of about seven to nine moderately long teeth, decreasing somewhat in length the more proximally they are situated. These teeth, some of which are reproduced in figs. 17 and 18, are furnished proximally with from one to three rather strong secondary teeth on each side; in addition they are provided on both sides with thin wing-like processes, which often continue with a free point to some distance beyond the central point, which is often well-rounded, of the tooth (fig. 17);

sometimes, however, the points of the wings do not reach the central point of the tooth: cf. fig. 18. Dorsally of the end comb there are a number (seven to nine, in most cases eight) of rather low, smooth, chitinous pegs, in most cases arranged in two irregular parallel rows running longitudinally. The cavity dorsally of the end comb is moderately deep.

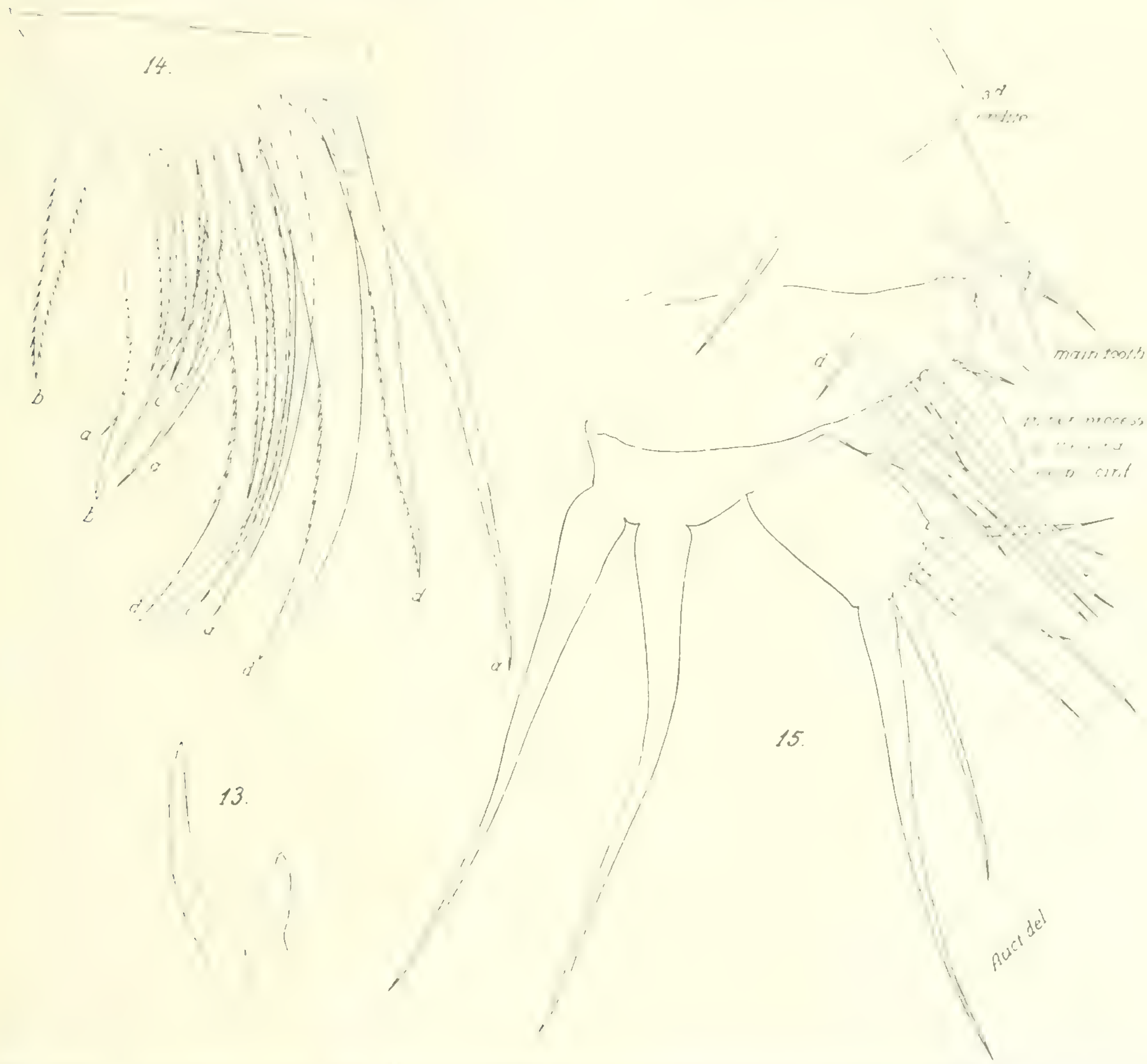

Fig. LXVIII. — *Ph. (Philomedes) globosa* (W. Lilljeborg). 13. Endite on the coxale of the mandible, seen from outside, ♂, 1000 ×. 14. The distal joint of the right maxilla seen from inside, ♂, 465 ×. 15. Right fifth limb seen from the front, the exopodite and the third endite of the protopodite; the bristles of the latter are not drawn, ♂; 312 ×. From specimens from Skager Rak.

F u r c a: — The type of the lamellae and the claws is about the same as that reproduced for *Ph. (Ph.) Lilljeborgi* in fig. 15. It has nine to twelve, in most cases ten, claws, decreasing fairly uniformly in length posteriorly; the number of the claws is sometimes the same on both lamellae, sometimes different. On the four or five posterior claws there are no long, stiff bristles

proximally and inwards; the other claws have at this part a cluster of bristles, varying somewhat in number. On the lamellae there are usually no long, stiff secondary bristles medially near the four or five anterior claws; medially near the posterior claws, on the other hand, there are often rather sparse bristles of this kind. At the anterior side of the first claw the lamellae often have short, fine hairs; behind the claws too the lamellae have short, fine hairs. Apart from these they are in most cases quite without hairs.

The rod-shaped organ (fig. 5, [illegible]): In specimens with shells from 2,7 to 3 mm. long the rod-shaped organ was from 0,5 to 0.6 mm. long. In most cases it was weakly bent ventrally; it is quite without joints; somewhat proximally of the middle the wall seems, however, somewhat weak (the organ is flexible here?); distally it is finely rounded; it is smooth.

Male: —

Shell: — Length 2.4–3.2 mm. As in the case of the females, large individuals, with shells from 2.9 to 3.2 mm. long, are found only in northerly locales, for instance at Greenland and Spitzbergen, etc. The males seem, on the average, to be slightly longer (not shorter, as other authors have stated, e. g. G. W. MÜLLER, 1901, p. 10) than the females from the same locale. Length : height, about 1.7 : 1; length : breadth about 2 : 1. Seen from the side (fig. 1), it has its greatest height at about the middle. The ventral margin is somewhat less arched than in the female; it has no pouting behind the incisur. The posterior projecting corner of the shell is rather broadly rounded; above this corner the margin of the shell is straight or weakly concave. The anterior and ventral corners of the rostrum, especially the latter, are well-rounded; the ventral corner has no spine-like process. The rostral incisur is almost rectangular; the small verruciform process, which in the female forms a boundary between it and the ventral margin of the shell, is practically absent altogether. Seen from beneath (fig. 2), it is of about the same type as the shell of the female, but somewhat narrower. Surface of the shell: The sculpture is somewhat more weakly developed than in the females. It has a few scattered bristles, some short and some long, just as in the female; the long ones, situated especially on the posterior part of the shell, are of the same type as the long ones in the female, but rather considerably longer. Seen from within: With regard to medial bristles and selvage there is a fairly close resemblance between the two sexes.

First antenna (fig. 8): — Most of the bristles on the second to the fifth joints are somewhat shorter than the corresponding bristles in the female; with regard to the four posterior bristles on the fourth joint it is to be noted that the two middle ones are somewhat longer than the medial and the lateral ones. In most cases there are no long secondary bristles on the anterior bristle of the second joint, on the shorter of the two anterior bristles of the third joint and on one to three of the four posterior bristles on the fourth joint. The sensory bristle of the original fifth joint has four sensorial filaments distally, situated in the same way as the distal sensorial filaments on the e-, f- and g-bristles of the female (cf. fig. 9). End joint: The a-bristle is about as long as the fifth joint and has no long secondary bristles. The b-bristle is about as long as the anterior sides of the third and fourth joints; it has two proximal and four distal

sensorial filaments; in the specimens from northern localities, Spitzbergen, Greenland, etc. one of these distal sensorial filaments was somewhat displaced proximally. The d-, e- and g-bristles are subequal, about as long as the total length of the three distal joints. The last-mentioned one has three proximal and four distal sensorial filaments, thus the same number as in the female. The c- and f-bristles are subequal or else the latter is somewhat shorter than the former; on all the specimens investigated the c-bristle had thirteen, the f-bristle twelve sensorial filaments, distributed fairly uniformly along the whole length of the bristle. The hairs on this limb are somewhat more weakly developed than in the female.

Second antenna: — Exopodite (fig. 10): This has about the following proportions between its joints:

I : II : III : IV : V : VI : VII : VIII : IX = 15 : 6 : 9 : 2 : 2 : 2 : 1,5 : 1 : 0,5,

i. e. the first joint is about as long as the total length of the second and third joints and the third joint is about as long as the total length of all the following joints. The bristle on the second joint is furnished ventrally at about the middle or somewhat proximally to this point with about four to six rather strong, smooth spines. The natatory hairs on the natatory bristles are perhaps somewhat wider than in the female. The end joint has only six bristles, one of the shorter ones of the female being missing; either both the two short bristles on this joint are provided with long natatory hairs or else the shorter one of them has short hairs. Endopodite (fig. 11): The first joint has quite the same equipment of bristles as in the female. The second and the third joints are long and of about the same length. The former has ventrally at the middle three moderately long, subequal bristles with short hairs. The latter is rather strongly bent; its concave side, which is turned towards the second joint, is somewhat undulated and has about five or six weak transverse chitinous ridges distally and no deep notch proximally; its proximal bristle is rather short, about a quarter or a third of the length of the joint, and rounded distally; its two distal bristles are subequal, about as long as the distal breadth of the joint.

Mandible: — Protopodite: The endite of the coxale is sometimes of about the type shown in the figure 13, sometimes it is of about the same type as in the female, only considerably smaller. The two main points are sometimes of about equal length, sometimes one is rather considerably longer than the other; the latter seems to be most often the case; the chitinization is weak, the bristle situated laterally at the base is similar to that in the female; there is most often scarcely any armature. Basale: The six proximal-medial bristles are of about the same length as in the female, all rather weak and finely pectinated; most of them are without any long secondary bristles; only the distal one often has a wreath of them at the middle. This joint has six or seven bristles ventrally, of the same length as in the female; the proximal ones have considerably more abundant long secondary bristles; these secondary bristles are, however, less stiff. Of the four dorsal bristles on this joint the long distal bristle is about the same as in the female, the three others are in most cases relatively shorter and have no long secondary bristles. The two bristles of the exopodite are in most cases without any long secondary bristles; sometimes, however, one or even both may have a wreath of these bristles

at the middle. E n d o p o d i t e: In a few cases five ventral bristles were observed on the first joint; from one to three of these bristles have no wreaths of secondary bristles; the bristles on the anterior side of the second joint are like those in the female, but have no long secondary bristles. The bristles of the end joint are somewhat shorter and weaker than those of the female; the proportion between the length of the anterior side of the second endopodite joint and the length of the longest claw is in the female about 28 : 28, and in the male about 28 : 24; the middle claws are finely pectinated. The pilosity is the same as in the female.

M a x i l l a: — P r o t o p o d i t e: The first endite has nine or ten bristles. E n d o p o d i t e: The first joint has four bristles postero-distally. The end joint had on one specimen only three a-bristles on the maxilla of one side, otherwise there were four as in the female. Apart from this it is equipped with bristles in quite the same way as the female. The proportion between the bristles is sometimes about the same as in the female, but it is subject to variation. The bristles of the protopodite and the exopodite, like those on the first endopodite joint, are furnished with long, soft hairs either at the middle or along the greater part of their length. Some of the bristles on the end joint of the endopodite may be sparsely furnished with soft hairs too. Pilosity: The first endopodite joint has very abundant and rather long hairs on the outside; on the protopodite and the end joint of the endopodite there are also groups of short, fine hairs to be observed.

F i f t h l i m b (fig. 15): — P r o t o p o d i t e: The three endites generally have the same number of bristles as in the corresponding processes in the female, though they sometimes have one or a few bristles less. E x o p o d i t e: The d-bristle on the second joint sometimes seems to be missing; the inner lobe of the third joint sometimes has four bristles; apart from this the equipment of bristles is similar to that of the female. The two bristles on the outer lobe of the third joint are somewhat larger than in the female and have very abundant long hairs. The outer of the six bristles on the fourth joint is often considerably longer than the other bristles on this joint and is often bare. The relative length and the pilosity of the bristles of this limb are subject to variation. Pilosity: Large parts of this limb have groups of short, fine hairs.

S i x t h l i m b: — The e p i p o d i a l a p p e n d a g e seems in most cases to be represented by only three short bristles.

S e v e n t h l i m b: — This is somewhat shorter than in the female; in specimens with shells about 3 mm. long it was about 1.4 to 1.6 mm. long. The secondary spines on the cleaning bristles proximally of the bells are more weakly developed than in the female or are quite absent. The end comb has the same or a slightly smaller number of teeth, which are, however, exceedingly weak, often arranged somewhat irregularly; their basal spines and wing-like processes are very weakly or not at all developed. The cavity situated dorsally of the end comb is often more or less compressed. The chitinous pegs on the dorsal edge of this cavity are in most cases somewhat fewer than in the female. It is probable that the end comb in this sex is not used as a cleaning organ in the real meaning of the term.

P e n i s (fig. 6): — One distal branch has near the base a somewhat bent and rather strongly chitinized peg-like process. Distally on the two distal branches there are in most

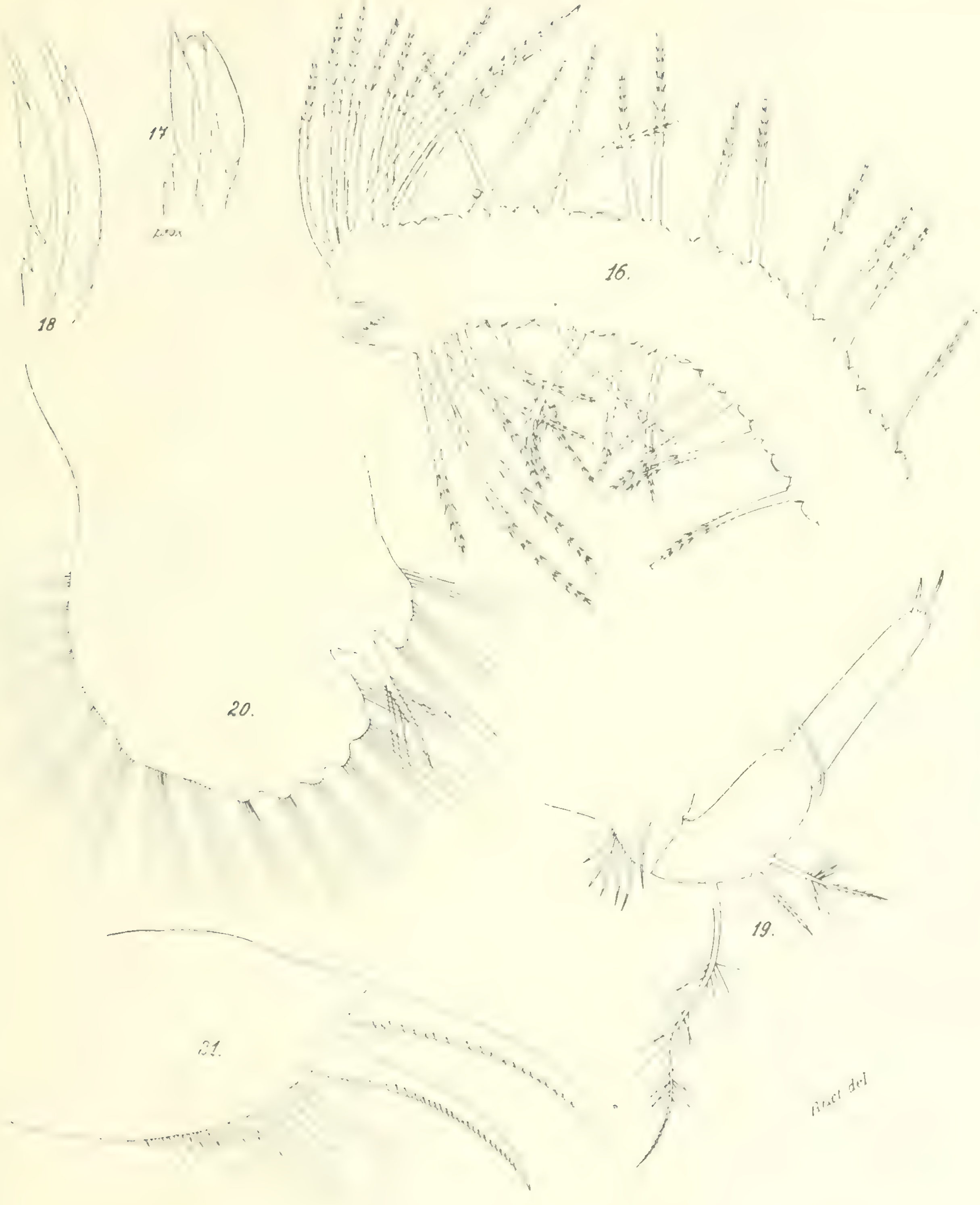

Fig. LXIX. — *Ph. (Philomedes) globosa* (W. Lilljeborg). — 16, Seventh limb, × 160 —. 17, One of the proximal teeth of the end comb of this limb, × 1200 —. 18, One of the distal teeth of the end comb, × 1200 —. 19, Endopodite of the second antenna, ♂, stage I, 160 ×. 20, Sixth limb, stage IV, 480 ×. 21, Furca, stage V, 312 ×. Figs. 16–18 from specimens from Greenland, figs. 19–21 from specimens from Skager Rak.

cases two bristles; at the base of the branch with the peg there are two more bristles situated close together and dorsally, more proximally, on the penis there are two bristles close to each other; all these bristles are short and subequal.

Furca (fig. 7): — The number of claws is on the average somewhat smaller than in the female, eight to ten were observed; in most cases nine claws were observed on one lamella and ten on the other; other combinations observed were: nine and nine, eight and nine. The anterior claws are somewhat more bent than in the female. The equipment of the claws is rather considerably weaker than in the female; claw no. 2 is furnished with two rows of teeth, the inner one of which is, however, in most cases rather sparse; on the three or four posterior claws there are no long bristles medially-basally.

Remarks: — As is seen from the list of synonyms given above this species is known in the literature principally under two names, *Ph. brenda* (W. BAIRD) and *Ph. globosus* (W. LILLJEBORG), the former of which has been used most frequently of late.

Which of these two names ought really to be used?

The original description of *Ph. brenda*, or, as W. BAIRD called this species, *Cypridina brenda*, is to be found in W. BAIRD's work of 1850 a, p. 181, pl XXIII, figs. 1, a–g. It is quite clear from this description that this form of BAIRD's cannot be considered identical with the one dealt with above by me. Whether it is identical with any other species now known seems to be impossible to decide with certainty, but it does not seem improbable that it belongs to the sub-genus *Vargula*. It is perhaps identical with *C. (V.) megalops* G. O. SARS. As an argument in favour of this statement of mine I may quote and discuss here a number of facts from BAIRD's description.

This author writes: „The shell or covering is oval, rounded at both extremities, rather narrower at the anterior, where it is deeply notched in front, producing a kind of short beak; . . . . the valves are smooth and tumid. — The eye is large and ovoid, with about twenty areolae. — The first pair of antennae is divided into five articulations; the first being the largest, and the others gradually becoming shorter as they descend, the last sending off four long, plumose filaments. The second pair is curved, and formed of five joints: the basilar being stout and rather short; the second, longer, arched on one side, and provided with three or four long, simple setae; the third is the shortest of all, with a projection on its under edge, which gives off two stout, plumose setae; the fourth, longer and narrower than the preceding, is armed on its outer edge with five simple setae; and the fifth is very slender, and terminated by four short, simple spines. — The natatory feet are large, and like those of preceding species „*(Ph. Mac Andrei)*", except that the long filaments are distinctly and beautifully plumose, and that there was apparently no appendage attached to the basilar joint."

The figure with which W. BAIRD illustrates his description of the shell agrees closely with the description. It shows a shell of an egg-shaped type, with its greatest height somewhat behind the middle and the posterior part of the shell clearly larger than the anterior part; the dorsal and the ventral margins are boldly, uniformly and almost symmetrically curved; the anterior and the posterior margins well rounded, the rostrum without a decided anterior corner,

In addition — unlike the shell of *Ph. Mac Andrei* — it is quite without any covering of hair. The agreement between this type of shell and that of *C. (Vargula) megalops* is striking. As is seen from the information given above, the females of the genus *Philomedes* have extremely strongly reduced lateral eyes or else the latter are quite absent. The species discussed by W. BAIRD has, on the other hand, large, well-developed lateral eyes, composed of about twenty ommatids. In this point too it thus agrees with *C. (V.) megalops*. It can be considered certain that the first antenna does not belong to any species belonging to the genus *Philomedes*; this is shown partly by the description quoted above and partly by the figure reproduced by W. BAIRD (fig. 1 e). Everything indicates, on the contrary, that we are concerned with a first antenna of a species belonging to the the sub-family *Cypridininae*. I wish here only to point out that a long powerful bristle issues posteriorly on the fifth joint (W. BAIRD says the fourth joint, but this writer has clearly overlooked the boundary between the third and the fourth joints). With regard to the natatory antenna it is clear from W. BAIRD's figure that only the bristle of the second joint on the exopodite is relatively short, without natatory hairs and furnished only with short secondary spines; the bristles on the third to the fifth joints are long natatory bristles with natatory hairs. There seems to be no endopodite on this limb. The latter fact may perhaps seem to support the identification of this species with G. O. SARS's *C. (Vargula) megalops*, as the endopodite is, as we know, very much reduced in the latter species. Two reproductions of the mandible — which BAIRD took to be the second antenna — are given, both very incomplete and impossible to use for the purpose of identification. One of these, fig. e, seems probably to belong to a species of the sub-family *Cypridininae*, the other (fig. e*) to a *Philomedes* species!

Additional facts could be given to show that this species of BAIRD's is not identical with the species dealt with by me above. It seems, however, superfluous to do so, as those already mentioned ought to be more than sufficient to show the impossibility of this identification.†

The first to identify this species of BAIRD's with LILLJEBORG's species was G. S. BRADY, 1868 b, p. 467. As a reason in favour of this identification only the following is given: „I have not had the opportunity of examining the type specimens of this species; b u t a s I b e l i e v e Dr. BAIRD considers them to be identical with *Bradycinetus globosus*, I have here adopted that view.“

It is consequently a very weak argument, which of course cannot influence in any way the statement made by me above as to the necessity of rejecting this synonymization. The name *brenda* is therefore not the right one to use for this species.

It may, on the other hand, be taken as absolutely certain that the species described by W. LILLJEBORG, 1853, p. 171, under the name of *Cypridina globosa* is identical with the form dealt with by me above. There are certainly differences in some details between LILLJEBORG's description and the facts observed by me — for these I need only refer the reader to a comparison between my description and LILLJEBORG's — but it is certain that these are to be accounted for by errors of observation on the part of LILLJEBORG. The type specimen of this species of

† It does not seem right definitely to identify *Cypridina brenda* with *C. (Vargula) megalops*, in which case the latter name would be rejected. The reasons for this identification are too weak. It seems best, at least for the present, to let this species of BAIRD's increase the list of unidentifiable species.

LILLJEBORG's — seems, as far as I can judge, to exist no longer. There are, on the other hand, topotype specimens both from Bohuslän and the west coast of Norway and Greenland. These have been investigated by me and their identity with the form described by me above verified. In addition I have investigated specimens caught at the type-locality of LILLJEBORG's species near Kullaberg in Skelderviken; these investigations too confirmed the above identification.

It is, however, only the female of this species that W. LILLJEBORG denotes by the name of *Cypridina globosa*. The male is described afterwards under the name of *Philomedes longicornis* (p. 176). Which of these two names of species ought to be used? According to the Art. 28 c in the International Rules for Zoological Nomenclature (Zool. Anzeiger, 1905), which reads: „Unter sonst gleichen Umständen ist derjenige Name vorzuziehen, der in der Veröffentlichung an erster Stelle angeführt wird". I have taken *globosa* as the name for the species in this work.

W. BAIRD states in his work of 1860 a, p. 200 that the species *Cypridina excisa* described by W. STIMPSON, 1853, p. 39 from Grand Manan is synonymous with his *Cypridina Brenda* and supports this synonymization by a personal examination of STIMPSON's specimens, „fide specimens". Whether this statement proves that this form of STIMPSON's is identical with the species described by me above is uncertain. The statements as to locale do not contradict it; as will be seen below, I have found *Ph. (Ph.) globosa* common in Fortune Bay, Newfoundland, which is a locale near STIMPSON's type-locale. STIMPSON's original description and figure are unfortunately too incomplete to permit of a certain identification. This synonymization would, however, make it necessary to assume that this author had committed very great mistakes in his reproduction of the shell and I have consequently considered it inconvenient to adopt this view of BAIRD's.

The chief reason why I — like a few preceding authors — have included *Asterope groenlandica*, S. FISCHER, 1855 — a form that has been incompletely and certainly very incorrectly described — as a synonym of the species dealt with here is that the very abundant Ostracod material I have had an opportunity of investigating seemed to indicate that this was the only species belonging to the family *Cypridinidae* that is found in Greenland — at any rate it is by far the most abundant. It was first included in the genus dealt with here by G. O. SARS, 1865, p. 110, and G. S. BRADY writes, 1868 b, p. 466 „and is either identical with, or closely allied to, *Bradycinetus Brenda*". In his Naples monograph G. W. MÜLLER writes of this species, that it „vielleicht" is a synonym of *Ph. (Ph.) globosa*.

The reason why A. M. NORMAN's *Philomede longicornis*, 1867, p. 198 and 1869, p. 295 has not been included as a synonym is that this writer identifies this species of LILLJEBORG's with *Philomedes interpuncta* (W. BAIRD). NORMAN, 1861, p. 280 also has a form *Ph. longicornis*; it is clear, however, from his accompanying figure that it is *Ph. interpuncta* and not *globosa* that was before the author on this occasion.

Nor are *Ph. longicornis* in the older works of G. S. BRADY (and D. ROBERTSON) included in the list of synonyms given above. This writer seems also in the beginning not to have distinguished between *Ph. globosa* and *interpuncta*; cf. G. S. BRADY, 1880, p. 154, where these two forms are synonymized.

It is evident that *Bradycinetus brenda*, G. S. BRADY, 1871, p. 292, does not even belong to the genus *Philomedes*, as is clearly shown by pl. XXVI, fig. 6. According to BRADY's own statement 1896, p. 650, this form is identical with the male of *Cypridina mediterranea* O. COSTA, and this statement is not contradicted by the figure in question.

It is possible that *Ph. brenda*, R. W. SHARPE, 1909, p. 428 is synonymous with the species dealt with here. The figure of the male shell given by SHARPE differs, however, so decidedly from the type of shell observed by me that it did not seem right to include this name in the list of synonyms given above.

Habitat: — West coast of Sweden:

S. of Hven, 16. VII. 1897, depth 36—41 m., clay: 5 specimens (Daga Exp., J. G. ANDERSSON);* W. of Landskrona, 1892, depth 10—20 m., clay containing dead shells: 1 specimen, (coll. H. MUNTHE); W. of Landskrona, 27. VI. 1892, depth 45—50 m., clay: 29 specimens (coll. H. MUNTHE); S. of Kullen, lat. 56° 12′ N., long. 12° 26′ E., 16. VII. 1878, depth 25 m., clay with sand and shells: 1 specimen („Gunhild“ Exp., HJ. THÉEL and F. TRYBOM); Skelderviken (type locality), 12 and 15. VII. 1897, depth 25 m., clay: 62 specimens (Daga Exp., J. G. ANDERSSON), R. M. S. 80; S. of Morupsbank, lat. 56° 50′ N., long. 12° 12′ E., 12. VII. 1878, depth 45 m., clay with worm tubes: 8 specimens („Gunhild“ Exp., HJ. THÉEL and F. TRYBOM), R. M. S. 81; W. of Varberg, 8. V. 1912: at the surface: 22 planktonic specimens, R. M. S. 104; depth 25 m., planktonic: 5 specimens, R. M. S. 105; depth 50 m., planktonic: 35 specimens, R. M. S. 106 (Swedish Hydr. Biol. Comm.); W. of Varberg, 9. V. 1912: at the surface, planktonic: 69 specimens, R. M. S. 107; depth 20 m., planktonic: 10 specimens, R. M. S. 108; planktonic just above the bottom: 66 specimens, R. M. S. 109 (Swedish Hydr. Biol. Comm.); Anholt, 28. V. 1912, planktonic just above the bottom: 2 specimens, R. M. S. 110 (Swedish Hydr. Biol. Comm.); E. of Nidingen lat. 57° 19′ N., long. 11° 27′, E., 10. VII. 1878, depth 80 m?, clay: 5 specimens (Gunhild Exp., HJ. THÉEL and F. TRYBOM), R. M. S. 82; Gullmar Fiord, Skår, depth 100 m., clay: 59 specimens (coll. S. LOVÉN), R. M. S. 85; Skår, 1897, depth 120 m., clay: 23 specimens (coll. J. G. ANDERSSON), R. M. S. 86; Skår, Aug. 1890, depth 125 m., clay: 1 specimen (coll. O. CARLGREN), R. M. S. 87; Gullmar Fiord, between Alsbäck and Skår, 5. VIII. 1896, depth 140 m., clay: 19 specimens (coll. J. G. ANDERSSON), R. M. S. 88; Gullmar Fiord, N. of Flatholmen, July 1896, depth 70 m., clay and sand: 13 specimens (coll. J. G. ANDERSSON), R. M. S. 89; Väderöarna (off Fjällbacka): 41 specimens (coll. S. LOVÉN), R. M. S. 90; Väderöarna, depth 70—100 m., coral bottom: 89 specimens (coll. A. v. GOËS), R. M. S. 91; Väderöarna, N. E. of Storön, 31. V. 1897, depth 50—107 m., coral bottom: 3 specimens (coll. J. G. ANDERSSON), R. M. S. 92; Väderöarna, E. of L. Knappen, 1. VI. 1897, depth 140 m., clay: 2 specimens (coll. J. G. ANDERSSON), R. M. S. 93; Koster, 2 Swedish miles W., 10. VIII. 1865, depth 100 m., clay: 1 specimen (coll. A. W. LJUNGMAN), R. M. S. 94; Koster, 5. VIII. 1865, depth 180 m., clay: 24 specimens (coll. A. W. LJUNGMAN), R. M. S. 97; Koster, 1865, depth 225 m., clay: 7 specimens (coll. A. W. LJUNGMAN), R. M. S. 99; E. of St. Sneholmen, Koster, depth 110 m.,

* [illegible]

clay with *Zostera*: 1 specimen (coll. J. G. ANDERSSON), R. M. S. 95; E. N. E. of St. Sneholmen, 18. V. 1897, depth 160 m., clay: 2 specimens (coll. J. G. ANDERSSON), R. M. S. 96; S. E. of St. Sneholmen, 29. V. 1897, depth 180 m., clay: 2 specimens (coll. J. G. ANDERSSON), R. M. S. 98; E. N. E. of St. Sneholmen, 31. V. 1889, depth 150—180 m., clay: 10 specimens (coll. J. ARWIDSSON), U. M.

Skager Rak:

The Norwegian Depression: 6. VII. 1877, depth 360 m., sand and clay: 7 specimens („Gunhild" Exp., station 10*, C. BOVALLIUS and HJ. THÉEL), R. M. S. 102.

West Coast of Norway:

Bergen, 1858: 100 specimens (coll. W. LILLJEBORG), U. M.; Grötsund, Okt., 1861, depth 45 m., clay: 1 specimen (S. S. E.), R. M. S. 49.

Nova Zembla:

Matotschkin Scharr, 8. VII. 1875, depth 9—18 m., sand: 4 specimens (A. E. NORDENSKJÖLD's Exp.), R. M. S. 54; Matotschkin Scharr, 10—13. IX. 1876, depth 19—27 m., clay and sand: 84 specimens (A. E. NORDENSKJÖLD's Exp.), R. M. S. 55—56; Besimannaja Bay, 1875: 5 specimens (A. E. NORDENSKJÖLD's Exp.), R. M. S. 57.

Spitzbergen:

King Charles' Island, lat. 78° 50′ N., long. 27° 39′ E., 12. VIII. 1898, depth 20 m., fine yellowish-red clay, temperature at the bottom +0.2° C: about 200 specimens (S. S. E.), R. M. S. 50; King Charles' Island, lat. 78° 50′ N., long. 29° 39′ E., 17. VIII. 1898, depth 60—70 m., fine dark gray clay: about 350 specimens (S. S. E.), R. M. S. 51; Rivalen's Sound, 8. VIII. 1898, depth 100—110 m., fine clay with stones, temperature at the bottom −1.45° C: about 175 specimens (S. S. E.), R. M. S. 52 and 53; Swedish Foreland, Cape Hammerfest, 8. VIII. 1898, depth 12—20 m., fine dark gray clay: 1 specimen (S. S. E.), R. M. S. 112; Mount Lovén, lat. 79° 20′ N., long. 19° E., 15. VIII. 1861, depth 180 m., fine clay: 1 specimen (S. S. E.), R. M. S. 3; Enbay, lat. 79° 45′ N., long. 20° E., 5. VIII. 1861, depth 90 m., fine clay: 1 specimen (S. S. E.), R. M. S. 4; Parry's Island, 8. IX. 1868, depth 55—70 m., gravel: 4 specimens (S. S. E.), R. M. S. 5; Castrén's Islands, 7. IX. 1868, depth 50—70 m., clay with stones: 103 specimens (S. S. E.), R. M. S. 6; Shoal Point, lat. 80° 9′ N., long. 18° E., 15. VII. 1861, depth 55 m., clay: 144 specimens, (S. S. E.), R. M. S. 7; Treurenberg Bay, lat. 79° 55′ N., long. 16° 5′ E., 8. VI. 1861, depth 25 to 40 m., clay: 1 specimen (S. S. E.), R. M. S. 9; at the same station, 17. VI. 1861, depth 55 m., clay with stones: 17 specimens (S. S. E.), R. M. S. 10; Mossel Bay, at 16 different stations, I.—IV. 1873, depth 3—18 m., sand or clay: about 650 specimens (S. S. E.), R. M. S. 11—24; lat. 79° 56′ N., long. 15° E., at the surface, planktonic, 3. VII. 1873: 10 mature males (S. S. E.), R. M. S. 25; lat. 80° N., long. 13° E., depth 125 m.: 18 specimens (S. S. E.), R. M. S. 26; Wijde Bay, July 1861, depth 55—70 m., clay: 1 specimen (S. S. E.), R. M. S. 27; Hakluyts Headland, lat. 79° 50′ N., long. 11° E., 22. V. 1861, depth 30 m., clay: some hundreds of specimens (S. S. E.), R. M. S. 28 and 29; Danes Gat, lat. 79° 40′ N., long. 11° E., 10. IX. 1861, depth 36 m., clay: 39 specimens (S. S. E.), R. M. S. 30; Kobbe Bay, depth 5 m., sand: 1 specimen (S. S. E.), R. M. S. 31; Ice Fiord, no definite locality, Sept. 1861, depth 4 m., algae: 24 specimens (S. S. E.),

* [illegible]

R. M. S. 32; Nord Fiord, lat. 78° 27′ N., long. 15° 20′, E., 19. VII. 1898, depth 175 m., dark brown clay: 4 specimens (S. S. E.), R. M. S. 34; Ice Fjord, Coles Bay, 22. VII. 1908, depth 3—4 m., temperature + 5° C, loose clay: 45 specimens (S. S. E.), U. M.; Sassen Bay, Sept. 1861, depth 18 m., clay: 49 specimens (S. S. E.), R. M. S. 35; at the same locality, Sept. 1861, depth 35 m., clay: 39 specimens (S. S. E.), R. M. S. 36; Advent Bay, Aug. 1861, depth 20—50 m., fine clay: 40 specimens (S. S. E.), R. M. S. 37; at the same locality, 10. VIII. 1908, depth 11—19 m., fine clay, temperature at the bottom + 3° C: 25 specimens (S. S. E.), U. M.; Ice Fiord, Cape Boheman, 21. VII. 1898, depth 36 m., clay and gravel: 20 specimens (S. S. E.), R. M. S. 113; Bel Sound, depth 10—20 m., clay: 16 specimens (S. S. E.), R. M. S. 38; at the same locality, depth 35 m., clay: 2 specimens (S. S. E.), R. M. S. 39; at the same locality, depth 55 m., clay: 16 specimens (S. S. E.), R. M. S. 40; Horn Sound, depth 70—100 m., clay with stones: 21 specimens (S. S. E.), R. M. S. 41; Whales Point, 9—10. VIII. 1864, depth 35—55 m., clay: 16 specimens (S. S. E.), R. M. S. 42; at the same locality, 10. VIII. 1864, depth 55—70 m., clay: 10 specimens (S. S. E.), R. M. S. 43; lat. 76° 40′ N., long. 18° E., 29. VII. 1868, planktonic at the surface: 21 specimens, males and females (S. S. E.), R. M. S. 45; Ginevra Bay, lat. 78° 35′ N., long. 20° E., 21. VIII. 1864, depth 7—12 m., fine clay: 13 specimens (S. S. E.), R. M. S. 46.

G r e e n l a n d:

Clavering Island, 17. VII. 1899, depth 25—40 m., mud and sand: some hundreds of specimens (S. G. E.), R. M. S. 59; Small Pendulum Island, lat. 74° 35′ N., long. 18° 23′ W., 6. VII. 1899, depth 18—21 m., mud and sand: 3 specimens (S. G. E.), R. M. S. 114; Franz Josef Fiord, lat. 73° 6′ N., long. 27° 17′ W., 12. VIII. 1899, depth 1—9 m., mud and sand: about 300 specimens (S. G. E.), R. M. S. 115; at the same locality, 11. VIII. 1899, depth 23 to 70 m., mud with sand and gravel: 6 specimens (S. G. E.), R. M. S. 116; lat. 73° 32′ N., long. 24° 35′ W., 28. VIII. 1899, depth 100—110 m., mud with gravel and stones: 2 specimens (S. G. E.), R. M. S. 117; lat. 72° 43′ N., long. 26° 50′ W., 23. VIII. 1899, depth 35—60 m., mud: 12 specimens (S. G. E.), R. M. S. 118; King Oscar Fiord, lat. 72° 56′ N., long. 24° 49′ W., 24. VIII. 1899, depth 125 m., mud with gravel and stones: 2 specimens (S. G. E.), R. M. S. 119; Scoresby Sound, lat. 70° 50′ N., long 22° 31′ W., 4. VIII. 1899, depth 9 m., mud with algae: 25 specimens (S. G. E.), R. M. S. 120; lat. 70° 27′ N., long. 22° 35′ W., 30. VII. 1899, depth 13—18 m., clay, mud and sand: 30 specimens (S. G. E.), R. M. S. 121; lat. 70° 43′ N., long. 22° 29′ W., 7. VIII. 1899, depth 70 m., mud: 2 specimens (S. G. E.), R. M. S. 122; Sukkertoppen, 24. VII. 1870, depth 100 m., clay: 4 specimens (S. G. E.), R. M. S. 60; Christianshaab, 28. VII. 1870, depth 5—9 m., clay with stones and algae: 13 specimens (S. G. E.), R. M. S. 61; at the same locality, 28. VII. 1870, depth 27—50 m., clay: 62 specimens (S. G. E.), R. M. S. 62; Claushavn, 4. VIII. 1870, depth 35 m., clay and stones: 146 specimens (S. G. E.), R. M. S. 63; at the same locality, 8. VIII. 1870, depth 500 m., clay: 4 specimens (S. G. E.), R. M. S. 64; Jacobshavn, 7. VIII. 1870, depth 60 m., clay: 133 specimens (S. G. E.), R. M. S. 65; at the same locality, 14. VIII. 1870, depth 215 m., clay and sand: some hundreds of specimens (S. G. E.), R. M. S. 66; Godhavn, depth 50—90 m., clay: 4 specimens (S. G. E.), R. M. S. 67; Disco Island, Nord Fiord, 11. VII. 1871, depth 280 m., loose gray clay: 5 specimens (S. G. E.), R.

M. S. 68; Umanak, depth 70—90 m., clay: some hundreds of specimens (S. G. E.), R. M. S. 70; at the same locality, fine clay, depth 450 m.: 25 specimens (S. G. E.), R. M. S. 71; Kikertak, Tossukateks Icefiord, 31. VIII. 1870, depth 50—70 m., clay: 96 specimens (S. G. E.), R. M. S. 72; at the same locality, 30. VIII. 1870, depth 100—125 m., on a rocky bottom: 5 specimens (S. G. E.), R. M. S. 73; at the same locality, 31. VIII. 1870, depth 125—250 m., clay and stones: 82 specimens (S. G. E.), R. M. S. 74; Aukpadlavtok, depth 450 m., fine clay: 56 specimens (S. G. E.), R. M. S. 75; Cape Dudley Diggers, 5. VII. 1894, depth 60—80 m., mud: about 70 specimens (S. G. E.), R. M. S. 79.

B a f f i n B a y:

Lat. 71° 10′ N., long. 58° 56′ W., 20. VII. 1871, depth 350 m., clay: 7 specimens, (S. G. E.), R. M. S. 76; lat. 72° 4′ N., long. 59° 50′ W.: 1 specimen (S. G. E.), R. M. S. 77.

N e w f o u n d l a n d:

Lat. 46° 13′ N., long. 51° 46′ W., 16. VIII. 1871, depth 100 m., sand and shells: 2 specimens (S. G. E.), R. M. S. 78; Fortune Bay, 8. VII. 1870, depth 35 m., clay: about 200 specimens (S. G. E.), R. M. S. 69.

Distribution: This species seems to be of an arctic-boreal nature — not arctic, as A. M. NORMAN states, 1891, p. 120. According to statements formerly made in the literature it occurs:* round Great Britain (G. S. BRADY, A. M. NORMAN and D. ROBERTSON), along the west and north coasts of Scandinavia (W. LILLJEBORG, G. O. SARS, A. M. NORMAN), in the Kara Sea and off the Murman coast (G. O. SARS and H. J. HANSEN), at Franz Josef Land (TH. SCOTT), Spitzbergen (W. LILLJEBORG, G. O. SARS), Jan Mayen (G. O. SARS), Greenland (W. LILLJEBORG, C. AURIVILLIUS, E. VANHÖFFEN, K. STEFFENSEN) and north of North America, lat. 77° N., long. 71° 37′ W. (W. BAIRD).

Relation to hydrographical conditions: — According to the results arrived at by the „C o n s e i l p e r m. i n t e r n a t. p o u r l'e x p l o r. de la mer", collected by C. APSTEIN, 1911, this species is restricted to comparatively low temperatures. It had been observed at 8.20 ° C and − 1.3° C. As is shown by the information given by me above, it has been found at a still lower temperature — 1,45° C. Salinity: from 35 to 19,96 ‰.

Ph. (Philomedes) Lilljeborgi (G. O. SARS).

Bradycinetus Lilljeborgi, G. O. SARS, 1865, p. 112.
Philomedes „ „ „ „ 1869, p. 357.
„ „ „ „ „ 1872, p. 280.
? *Bradycinetus* „ G. S. BRADY and D. ROBERTSON, 1872, p. 70.

* Not on the coast of Finland. This information, which is found in G. W. MÜLLER's work of 1901, p. 10, is certainly a mistake; presumably it is, as is already pointed out by C. APSTEIN, 1911, p. 168, a misprint for Finmarken. Not in the Bay of Biscay, as G. W. MÜLLER states, 1912. This statement, taken from G. S. BRADY's work of 1871, p. 292, refers to another species; cf. above.

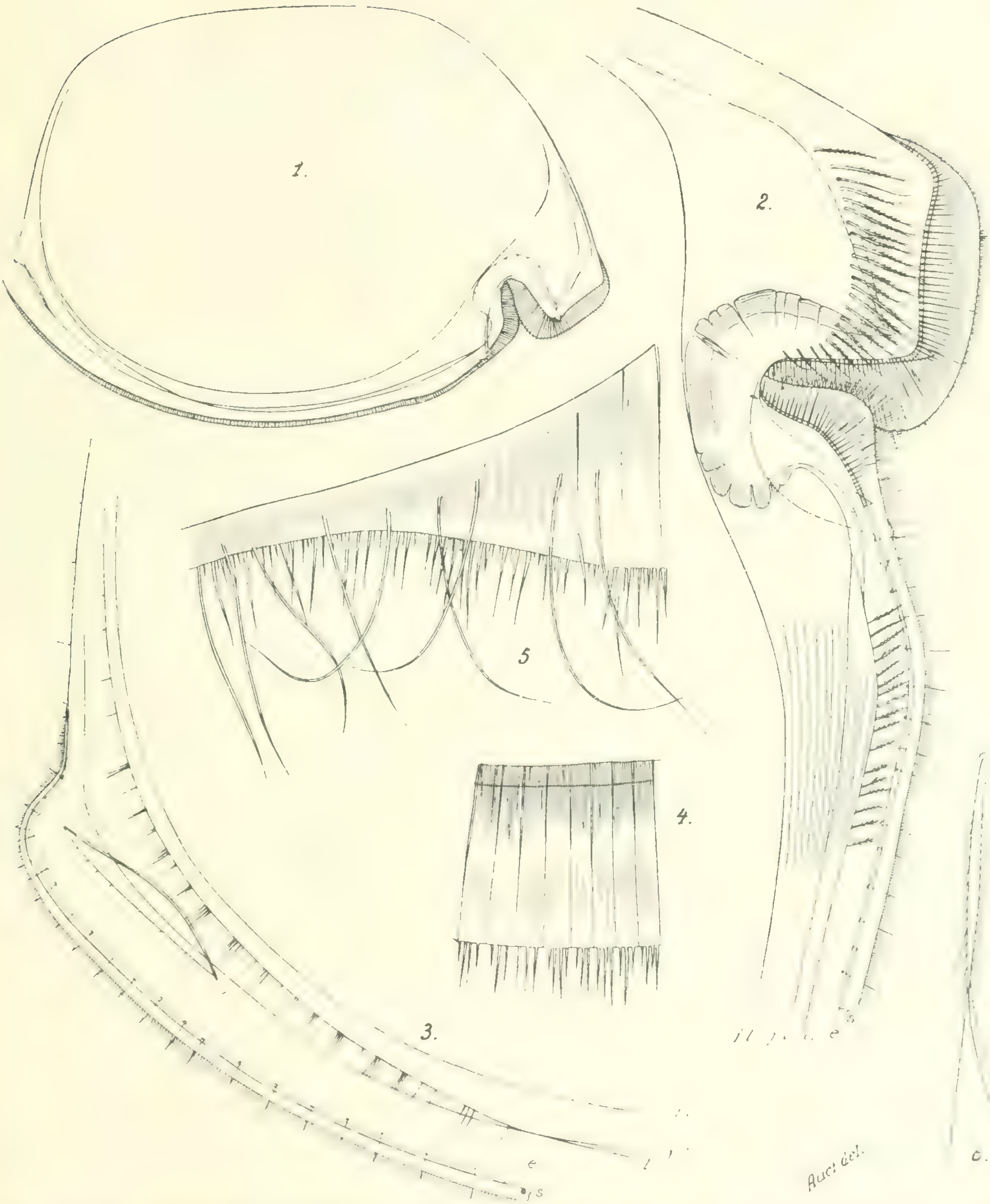

Fig. LXX. — *Ph. (Philomedes) Lilljeborgi* (G. O. Sars). — 1. Right valve seen from the side: 39 ×. 2. Anterior part of the left valve seen from inside: 100 ×. 3. Posterior part of the left valve seen from inside: 100 ×. 4. A part of the selvage of the ventral margin of the rostrum: 325 ×. 5. A part of the selvage just behind the rostral incisur: 500 ×. 6. Medial bristle from the rostrum: 500 ×. All figures are drawn from a specimen determined by G. O. Sars.

Philomedes Lilljeborgi G. O. SARS, 1886, p. 74.
.. .. A. M. NORMAN, 1891, pp. 119, 121.
.. .. G. S. BRADY and A. M. NORMAN, 1896, p. 658, pl. LI., figs. 4 to 6; pl. LII, figs. 3, 4.
.. .. H. H. GRAN, 1902, pp. 20, 66, 80, 210.
.. .. P. T. CLEVE, 1903, p. 24.
.. .. C. H. OSTENFELD, 1906, p. 97.
.. .. and C. WESENBERG-LUND, 1909, p. 114.
.. .. C. APSTEIN, 1911, p. 169, pl. XXIII, fig. 4.

Description: Female: —

Shell: — Length 2,15—2,6 mm. It does not seem to be decidedly larger in northern than in southern locales; a few specimens from Lofoten that I had an opportunity of investigating had shells about 2,3 mm. long, which was the average length of the specimens from Skager Rak that were investigated by me. Length : height, about 1,45 : 1; length : breadth, about 1,8 : 1. Seen from the side (fig. 1) it is „rounded-sub-quadrangular", with its greatest height at about the middle. The dorsal margin is only weakly arched, sometimes almost straight, running almost parallel with the longitudinal axis of the shell, and with broadly rounded corners passing into the rather steeply descending anterior and posterior margins. The ventral margin is uniformly and moderately curved and weakly pouting just behind the rostral incisur. The posterior part of the shells forms, somewhat ventrally of half the height of the shell, a rather small but characteristic beak — which is perhaps the easiest means of distinguishing this species from *Ph. (Ph.) globosa.* Above this beak-like process the posterior margin of the shell is straight or very slightly arched. The rostrum has in most cases a rather pointed anterior corner, which projects almost at right angles; its ventral corner is rather pointed and is armed with a small spine-like process. The rostral incisur is rather deep and narrow, defined from the ventral margin of the shell by a slight protuberance. Seen from beneath the shell is oval with its greatest breadth at about the middle; the anterior and posterior extremities are almost similar, the side contours are uniformly curved (agreeing fairly well with pl. LII, fig. 4, G. S. BRADY and A. M. NORMAN, 1896). The surface of the shell is smooth, without any marked protuberances except the little spine on the ventral corner of the rostrum and a very slight ridge behind the rostral incisur, running out on the little protuberance, which, as has been mentioned above, marks off the rostral incisur from the ventral margin of the shell. It has only some scattered and moderately long bristles; these bristles are characterized by coming to a fine point from a rather broad basal part — they are of about the same type as the long bristle in fig. 4 of *Ph. (Ph.) globosa.* The pores of the surface are of moderate size, rather numerous and often very difficult to observe with certainty. Seen from inside (figs. 2 and 3): Medial bristles: The row of bristles on the rostrum consists of a rather large number of bristles, about as in fig. 2. On the posterior portion of the list there is a moderate number of bristles, partly arranged in small groups. On the part of the shell between this part of the list and the margin of the shell there are a few very short bristles.

Fig. LXXI. *Ph. (Philomedes) Lilljeborgi* G. O. Sars, ♀. 7. Left first antenna, seen from inside: 105 ×. 8. The end joint of this antenna, seen from outside: 312 ×. 9. The endopodite of the right second antenna (normal type): 248 ×. 10. The endopodite of the left second antenna (abnormal type): 248 ×. (All the drawings from a specimen determined by G. O. Sars.)

On this part there is also an elongated little pocket, situated about parallel to the margin of the shell; on the edge of this pocket there are often a few extremely short bristles; this pocket is often full of all sorts of dirt. For the selvage see figs. 4 and 5. The marginal bristles on the rostral selvage are rather short. According to G. O. SARS's statement the shell has a pale yellowish colour.

First antenna (fig. 7): — Of the three bristles on the second joint the posterior one, which is somewhat longer than the two others, is usually as long as the total length of the third and fourth joints. The third joint has three or four, usually three, bristles anteriorly; the anterior one of these is rather short, usually not quite so long as this joint, the others are subequal and in most cases about as long as the fourth joint. The posterior bristle on this joint is short, about half the length of the next joint or somewhat longer. The fourth joint has the same bristles as in *Ph. (Ph.) globosa*; their length is, however, on the average, somewhat less than in this species, the two medial ones and the four posterior ones especially are rather short. The bristle on the fifth joint is about the same length as this joint. The a-bristle on the end joint is about the same as the anterior bristle on the fourth joint. Most of these bristles have one or a few wreaths of long, stiff secondary bristles at the middle; these are, however, often missing on the short anterior bristle and the posterior one on the third joint. Variation in the secondary bristles may, however, be observed; in the length of the bristles so far mentioned I have also observed some, though only rather slight, variation. The bristles of the end joint (fig. 8) have the same equipment as in *Ph. (Ph.) globosa*, i. e. the b-bristle with one proximal and three distal sensorial filaments, the c-bristles with five proximal and four distal sensorial filaments, the f- and g-bristles with four and three proximal sensorial filaments respectively and four distal sensorial filaments; in one specimen six proximal filaments were observed on one c-bristle on the antenna of one side. The pilosity is about the same as in *Ph. (Ph.) globosa*.

Second antenna: — Exopodite: This is very like that of *Ph. (Ph.) globosa*. The proportion between the length of the first joint and the total length of all the following joints is about 43 : 37. In some cases females with rather large eggs in the brood chamber were discovered with their long natatory bristles quite intact; in most cases, however, these natatory bristles were broken off as in *Ph. (Ph.) globosa*. This may perhaps indicate that this character, of having the long natatory bristles broken off is not completely fixed in this species. There seem sometimes to be no basal spines at all on the second, or the second and third, joints. In most cases the basal spines are simple; sometimes, however, they have two or three points. In some cases one or more small spines may be observed close to one or more of the basal spines (cf. p. 385 above). Endopodite (figs. 9 and 10): The first joint has quite the same equipment of bristles as this joint in *Ph. (Ph.) globosa*. The second joint has several bristles ventrally: One rather long one — its length varies somewhat, however — situated somewhat proximally of the middle of the joint; this bristle is furnished at the middle with several irregular wreaths of long, stiff secondary bristles and with short hairs distally. Distally of this bristle there are in most cases three moderately long bristles; on one specimen only two bristles were observed on the antenna of one side; whether the third had been broken off could not be decided with any certainty, though probably it had not been. G. S. BRADY and A. M. NORMAN, 1896

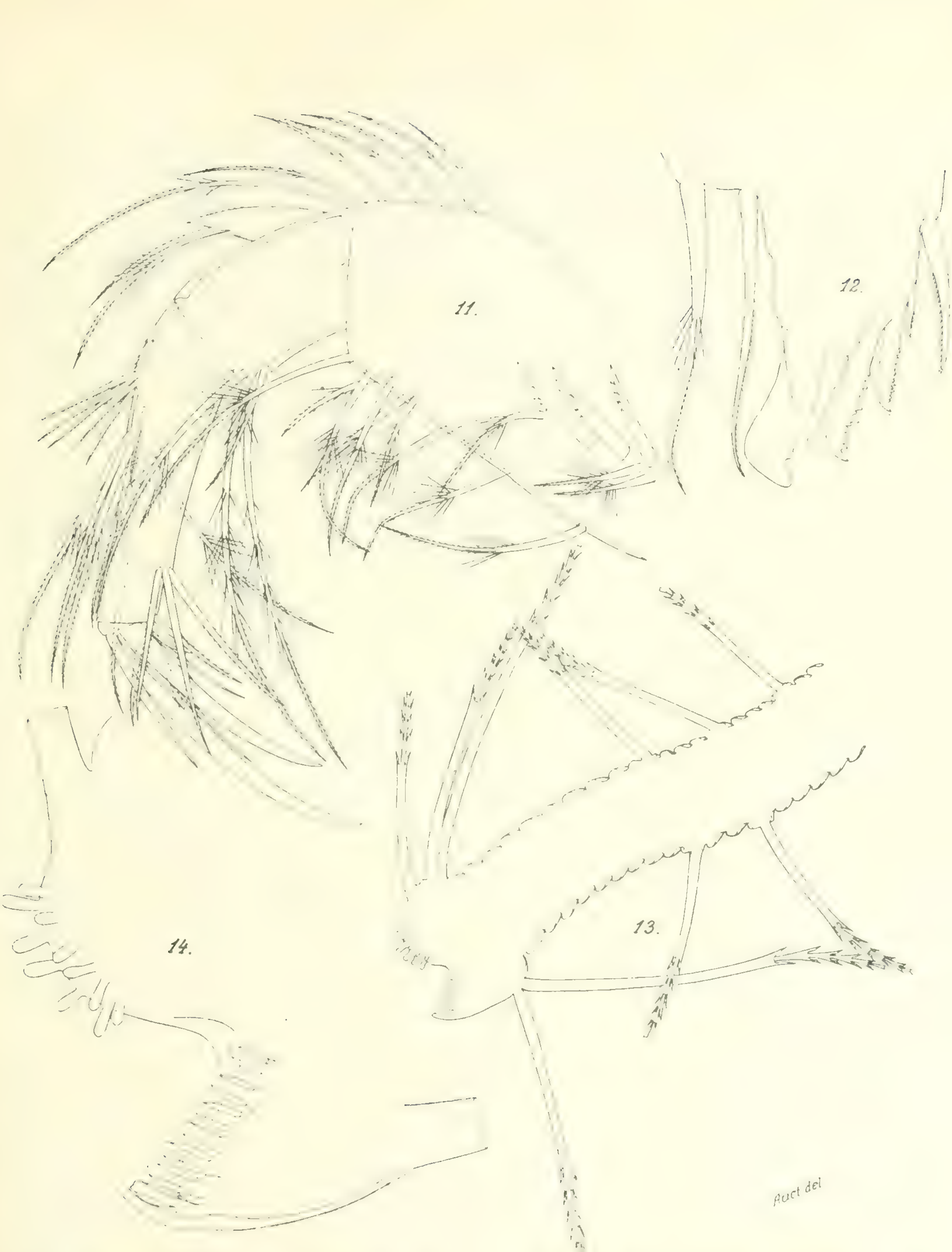

Fig. LXXII. — *Ph. (Philomedes) Lilljeborgi* (G. O. SARS) ♀. — 11. Right mandible, seen from inside. 192 ×. 12. The main tooth of the first exopodite joint of the fifth limb. 580 ×. 13. Seventh limb. [illegible] ×. 14. End part of this limb. 980 ×. All these drawings from G. O. SARS's specimen.

pl. I.I, fig. 6, show only two of these bristles. These bristles vary both with regard to length and equipment: differences may be observed, not only between one individual and another, but also between the right and left antennae of the same individual. Sometimes it is the distal one, sometimes the proximal one and sometimes the middle one that is longest; sometimes one or two of them have an irregular wreath of long, stiff secondary bristles at the middle and short hairs distally, while the two or one that remain have short hairs; sometimes all three have only short hairs. The distal bristle of this joint is about as long as the joint or somewhat longer; it is finely rounded distally. On one antenna of one individual there was observed, proximally on this bristle, a protuberance of about the same type as G. W. MÜLLER observed on *Ph. levis* (1894, pl. 3, fig. 31).

M a n d i b l e (fig. 11): — This is very like that of *Ph. (Ph.) globosa.* P r o t o p o d i t e: The basale has eight or nine bristles ventrally, of about the same length as in the species just mentioned. Dorsally this joint has, besides the two distal bristles, five (sometimes four) bristles on the distal half. As in *Ph. (Ph.) globosa* the shorter distal bristle is about as long as the anterior side of the first endopodite joint, the longer one is about twice as long. The remaining five are subequal and about as long as the shorter distal bristle. In most cases all these bristles of this joint have a wreath of long, stiff secondary bristles at the middle and exceedingly fine hairs distally; sometimes, however, there may be no wreath on some of them. E n d o p o d i t e: The second joint differs from *Ph. (Ph.) globosa* by having five, sometimes even six, bristles in the anterior-proximal group.

M a x i l l a: — This is very like that of *Ph. (Ph.) globosa.* We may note: P r o t o p o d i t e: On the boundary between the protopodite and the endopodite there are on the anterior edge of the palp two bristles with short hairs, usually subequal and varying somewhat in length, sometimes only about half as long as the first endopodite joint, sometimes about as long as the corresponding bristle in *Ph. (Ph.) globosa.* On one specimen three of these bristles were observed in this place on one maxilla. E x o p o d i t e: The equipment of the three bristles is rather variable; the short bristle often seems to be without long secondary bristles. E n d o p o d i t e: End joint: This has usually, as in *Ph. (Ph.) globosa,* four, sometimes five, a-bristles; on one specimen three b-bristles were observed, two of which were powerful; four or five, usually four c-bristles; the three d-bristles are sometimes subequal, in most cases, however, the relation between their lengths is the same as in *Ph. (Ph.) globosa.*

F i f t h l i m b: — This is quite like this appendage in *Ph. (Ph.) globosa.*

S i x t h l i m b: — This is very like that of *Ph. (Ph.) globosa*; we may note that the second joint of the exopodite has 28—33 bristles.

S e v e n t h l i m b (fig. 13): — This has about the same relative length as the corresponding appendage in *Ph. (Ph.) globosa.* The cleaning bristles are relatively few, usually ten, sometimes eleven, of moderate, somewhat varying length. Usually six of these are situated dorsally, three close together distally and three scattered somewhat proximally of the former. Four, sometimes five, are situated ventrally, two close together distally and two or three somewhat proximally of the former. Equipment of the cleaning bristles: Three to six bells cut off transversally

distally; also the tongue of the distal bell is cut off rather transversally distally; proximally of the bells these bristles are furnished with short hairs, which are either rather fine or comparatively coarse; at least some of them are arranged in a few wreaths; sometimes these hairs seem to be almost completely absent. The end comb (fig. 14) consists of about eleven to seventeen teeth of moderate length and strength, decreasing somewhat in length the more proximally they are situated. These teeth are furnished proximally on both sides with a powerful secondary spine and are rather well rounded distally; they are provided on each side with a thin wing-like process, which in most cases, as far as I could see, did not continue as free points (as is the case in *Ph. (Ph.) globosa*). The cavity dorsally of the end comb is rather deep. Between the end comb and the distal dorsal bristles there are two parallel and somewhat irregular rows, running

15.

Fig. LXXIII. — *Ph. (Philomedes) Lilljeborgi* (G. O. SARS), ♀. — 15. Furca seen from inside; the teeth are not drawn; 120 ×. (From a specimen determined by G. O. SARS.)

longitudinally, of rather short, claviform, smooth chitinous pegs, each row comprising about four or five pegs (sometimes somewhat fewer, broken?).

F u r c a (fig. 15): — This has ten claws, decreasing fairly uniformly in length and strength posteriorly. On the three posterior claws there are no long, stiff bristles proximo-medially. Otherwise it is about the same as in *Ph. (Ph.) globosa.*

R o d - s h a p e d o r g a n: — This is of quite the same type as in *Ph. (Ph.) globosa*; its length is a little more than 0,3 mm.

For the m a l e cf. the description by G. S. BRADY and A. M. NORMAN, 1896, p. 658.

Remark: — On account of the incompleteness of the original description of this species I wrote to Professor G. O. SARS for permission to re-examine the type-specimen. In answer to my request Professor SARS informed me that the type-specimen seemed unfortunately to have been lost, but sent me at the same time, however, two specimens (one male and one female) taken at Vallö, Christiania Fjord, thus near the type-locality which had been determined by him as belonging to this species. The determination of G. O. SARS' is presumably quite correct. The new description of this species given above is based on this female; of course several other specimens were also taken into account. The male sent by G. O. SARS was unfortunately so dirty that it was not suitable for description and reproduction.

The material on which my description is based.

Habitat: — West coast of Sweden:

Koster (Bohuslän), E. N. E. of Stora Sneholmen; 18. V. 1897; depth down to 160 m.; clay: 1 mature female (coll. J. G. ANDERSSON); R. M. S. 123. Koster; 5. VIII. 1865; depth, 180 m.; clay: 130 specimens, mature females and larvae (coll. unknown); R. M. S. 125. The same locality; 24. VII. 1865; depth, 225 m.: 98 specimens, mature females and larvae (coll. unknown); R. M. S. 124.

Christiania Fiord:

Vallö; depth, 360—400 m.: 11 specimens, mature females and larvae (coll. G. O. SARS); Chr. Z. M.

Skager Rak:

„Skager Rak" (without definite localities; the depths indicate, however, that all these samples were taken in the Norwegian Depression; coll. J. LINDAHL): depth, 150 m.: 9 specimens, females and larvae, R. M. S. 126; depth, 200 m.: 2 females, R. M. S. 127; depth, 300 m.: 15 specimens, mature females and larvae, R. M. S. 128; depth, 350 m.: 211 specimens, mature females and juvenes, R. M. S. 129. Lat. 58° 26′ N., long. 9° 40′ E.; 4. VII. 1872; depth, 350 m.; clay: 1 mature female (coll. J. LINDAHL); R. M. S. 130. „Bassinen" in the Norwegian Depression (no definite locality); 6. VII. 1877; depth, 360 m.; clay mixed with sand: 1 female (Swedish „Gunhild" Exp., st. 10., C. BOVALLIUS and HJ. THÉEL); R. M. S. 131. Lat. 58° 21′ N., long. 9° 11′ E.; 17. VII. 1879; depth, 360 m.; fine brown clay: 2 females (Swedish „Gunhild" Exp., st. 14, C. BOVALLIUS and HJ. THÉEL); R. M. S. 132. Lat. 58° 14′ N., long. 8° 56′ E.; 17. VII. 1879; depth, 415 m.; fine brown clay: 11 specimens, mature females and juvenes (Swedish „Gunhild" Exp., st. 15, C. BOVALLIUS and HJ. THÉEL); R. M. S. 133.

West coast of Norway:

Lofoten Islands at a depth of 360—540 m.: 5 specimens, mature females and juvenes; collector unknown; R. M. S. 134.

Distribution: — Skager Rak; west coast of Norway, Beeren Island (H. H. GRAN) Iceland (H. H. GRAN); between Faroe Islands and Norway and between lat. 45° and 50° N., long. 10° and 15° W. (G. S. BRADY and A. M. NORMAN).

Ph. (Philomedes) Eugeniae n. sp.

Description: — Female: —

Shell: — Length 1.6—1.75 mm.; length : height, about 1,5 : 1; length : breadth about 1.85 : 1. Seen from the side (fig. 1) it has its greatest height at the middle. The dorsal margin is rather strongly and almost uniformly curved, sometimes, however, somewhat less than is shown in the figure; in most cases it passes over into the anterior and posterior margins without any decided corners; sometimes, however, when the dorsal margin is less strongly arched, distinct, though broadly rounded, corners may be observed. The ventral margin is uniformly arched, but less strongly than the dorsal margin; it is weakly pouting just behind the incisur.

The posterior part of the shell is, at about a third of the height of the shell, drawn out into a well-marked, almost rectangular, and in most cases rather pointed, corner—sometimes, however, somewhat less pointed than in the accompanying figure. Above this corner the posterior margin of the shell is very weakly concave or almost straight. The rostrum has a rather strongly projecting, almost rectangular, but rounded, anterior corner; its ventral corner is about of the same shape as the anterior one and has an exceedingly small, almost completely reduced, spine. The incisur is rather narrow and deep, and not, as in *Ph. (Ph.) globosa*, *Lilljeborgi* and several other species of this genus, marked off from the ventral margin of the shell by a protuberance. S e e n f r o m b e n e a t h the shell is oval, with its greatest breadth at about the middle, the anterior and posterior ends being almost symmetrical, the side contours uniformly curved. The s u r f a c e o f t h e s h e l l is, at least partly, covered with small, rounded, shallow, rather close foveolae, in most cases difficult to observe, but apart from these it is quite without sculpture. It has rather sparse, scattered and rather long bristles, somewhat more numerous near the margin of the shell; these bristles are characterized by the fact that they suddenly grow narrower from a rather thick basal part (of about the same type as the long bristle in fig. 4 of *Ph. (Ph.) globosa*). The pores of the surface are difficult to observe, rather small and numerous. S e e n f r o m i n s i d e: Medial bristles: The bristles in the row on the rostrum are rather numerous (about the same as in figs. 2 and 6 of *Ph. (Ph.) Lilljeborgi*). On the posterior part of the list there is a moderate number of bristles, partly arranged in small groups. On the part of the shell between this part of the list and the margin of the shell there are a few bristles (of about the same type as in fig. 3 of *Ph. (Ph.) Lilljeborgi*). There is no such pocket as characterizes this latter species. The selvage on the rostrum has short, marginal hairs.

F i r s t a n t e n n a: — The three bristles on the second joint are most frequently subequal and about as long as the fourth joint. Either all the bristles or one of the two anterior ones and the posterior bristle on the third joint were without long secondary bristles in the case of the specimens investigated by me. The same was true of the a-bristle on the end joint. Each of the other bristles on the second to the fifth joints had only one wreath of long, stiff secondary bristles at the middle. Otherwise this antenna agrees very closely with that of *Ph. (Ph.) globosa*. No variation was observed in the sensorial filaments on the end bristles.

S e c o n d a n t e n n a: — E x o p o d i t e: This is very like that of *Ph. (Ph.) globosa*. The bristles on the second to the fifth joints are about as long as the total length of the two or three proximal joints and are furnished at about the middle with a series of about ten rather strong, smooth ventral spines. The long natatory bristles were unbroken in the females investigated by me, although some of these had rather large eggs in their brood chambers. E n d o p o d i t e (fig. 2): The first joint is of the same type and has the same equipment of bristles as this joint of *Ph. (Ph.) globosa*. The second joint is rather elongated and has two bristles ventrally, somewhat proximally of the middle, the one situated somewhat proximally of the other. The proximal one of these bristles is rather long and has several wreaths of long, stiff secondary bristles at the middle and short hairs distally. The distal one is rather short and has only short hairs. The end bristle on this joint is somewhat longer than the joint and is finely rounded distally.

M a n d i b l e: — With regard to this limb the type-specimen showed practically complete agreement with *Ph. (Ph.) globosa.* In a few other specimens this limb was rather considerably more slender, and its bristles, especially those on the endopodite, were relatively shorter; on the latter specimens the secondary bristles also seemed to be more weakly developed.

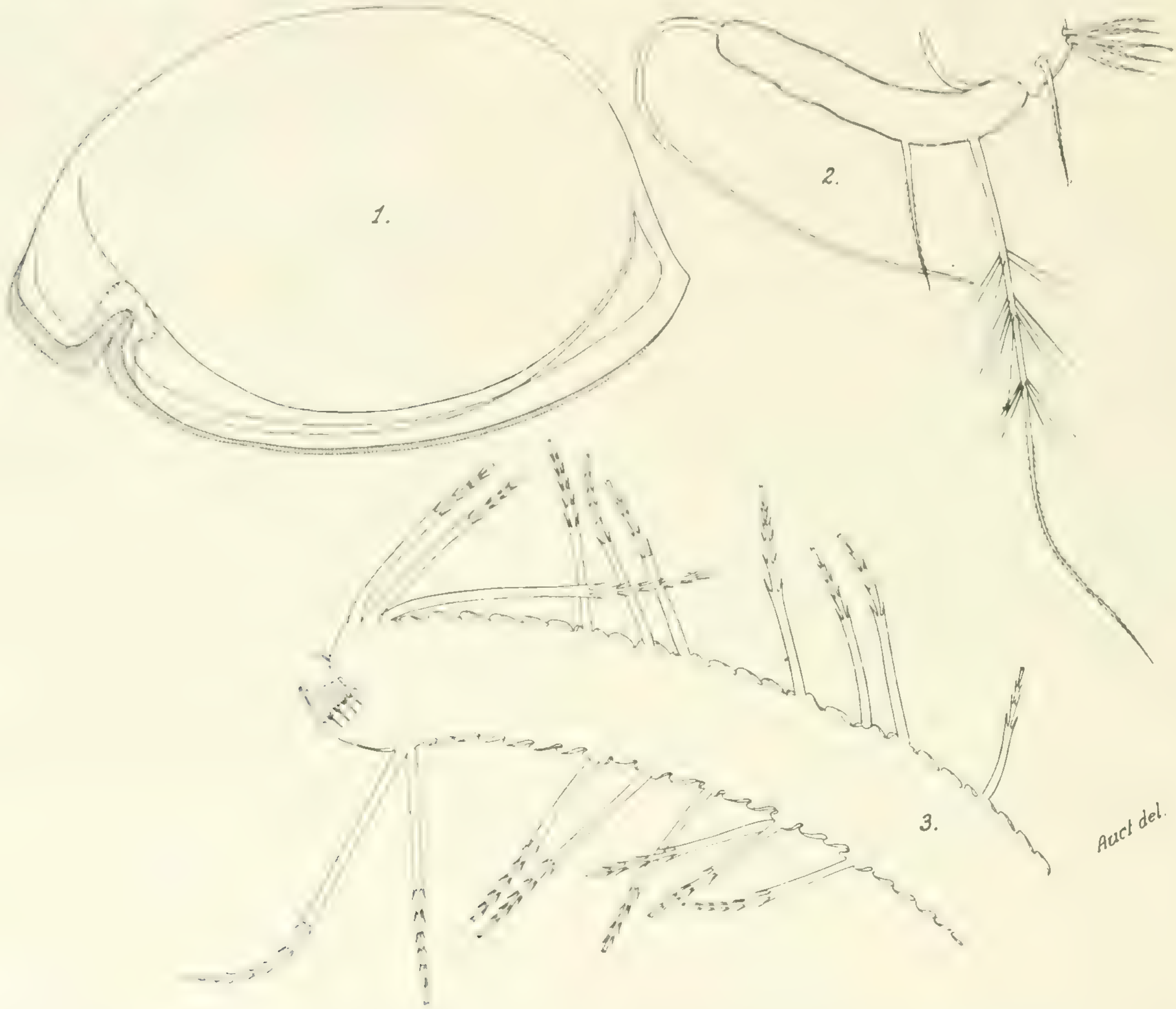

Fig. LXXIV. — *Ph. (Philomedes)* ***Eugeniae*** n. sp., ♀. — 1. Shell, seen from the side; 56 ×. 2. Endopodite of the left second antenna seen from inside; 312 ×. 3. Seventh limb; 312 ×.

In one case three bristles in addition to the two distal bristles were observed dorsally on the second protopodite joint.

M a x i l l a: — This is like this limb in *Ph. (Ph.) globosa.* The equipment of almost all the bristles is somewhat weaker than in the species mentioned. P r o t o p o d i t e: The bristle on the anterior side of the palp on the boundary between the protopodite and the endopodite is comparatively short, being sometimes not even half as long as the first endopodite joint; it has no long secondary bristles. E x o p o d i t e: Its three bristles have in most cases only

a very few long secondary bristles. E n d o p o d i t e: The first joint has distally-posteriorly only four bristles. The end joint has three a-bristles and three c-bristles; the d-bristles are often subequal.

F i f t h l i m b: — This is very like this appendage in *Ph. (Ph.) globosa.* As a rule, however, the equipment of most of the bristles seems to be somewhat more weakly developed than in this species.

S i x t h l i m b: — This is very like that of *Ph. (Ph.) globosa*; we may add that the epipodial appendage is represented only by three bristles and that the second joint of the exopodite has only seventeen to twenty bristles.

S e v e n t h l i m b (fig. 3): — This has about the same relative length as the corresponding appendage in *Ph. (Ph.) globosa.* There are, as in *Ph. (Ph.) Lilljeborgi* and *rotunda*, three dorsal and two ventral cleaning bristles situated close together distally; proximally of these there are from five to seven dorsal and four to six ventral bristles scattered irregularly. The cleaning bristles are moderately long and differ somewhat in length from each other, varying also to some extent from individual to individual and on the right and the left limb of the same individual. They are furnished with three to seven bells cut off transversally distally, the tongue of the distal bell being also cut off transversally. Proximally of the bells these bristles are furnished with short, and in most cases rather fine, hairs, partly, at least, arranged in one or a few wreaths; these hairs seem sometimes to be almost entirely lacking. The end comb consists of eleven to fifteen teeth of the same type as is described for *Ph. (Ph.) rotunda.* The cavity dorsally of the end comb is rather deep and is furnished dorsally with two rather small, claviform, smooth chitinous pegs.

F u r c a: — The five posterior claws have no long basal-medial bristles. Apart from this the furca of this species agrees completely with this organ in *Ph. (Ph.) Lilljeborgi.*

R o d - s h a p e d o r g a n: — This is of precisely the same type as that of *Ph. (Ph.) globosa.* It is about 0,3 mm. long.

The m a l e is unknown.

Remark: — This species is very closely related to *Ph. (Ph.) assimilis* G. S. BRADY, but differs from it by the equipment of the endopodite of the second antenna and by having more numerous cleaning bristles on the seventh limb. In addition, unlike the species just mentioned, it has not the peculiarity that the older females break off the natatory bristles on the second antenna. *Relation to other species.*

Habitat: — T i e r r a d e l F u e g o: Strait of Magellan; depth, 7 m.: 3 mature females (T h e S w e d i s h „E u g e n i e“ - E x p e d i t i o n, 1851—1853); R. M. S., on slides. Off Cape Valentyn; 12. III. 1896; depth, 270 m.; bottom of dead shells: 1 mature female and 5 juvenes (T h e S w e d i s h M a g e l l a n E x p e d.); R. M. S. 135.

Type specimen: on slides in R. M. S.

Ph. (Philomedes) rotunda n. sp.

Description: — Female: —

Shell: — Length, 1.9—2.1 mm.; length : height about 1.3 : 1; length : breadth about 1.6 : 1. Seen from the side (fig. 1) it has a broad oval shape, with its posterior part somewhat larger than the anterior part, the greatest height being at about the middle. The dorsal, posterior and ventral margins are uniformly rounded, passing into each other without any corners; the ventral margin is weakly pouting just behind the incisur. The rostrum has a broadly rounded anterior corner, its ventral corner is rather pointed, but is without any spine (such as we find, for instance, in *Ph. (Ph.) globosa, Lilljeborgi* and other species of this sub-genus). The incisur is moderately deep and narrow, and is not marked off from the ventral margin of the shell by any protuberance (cf., for instance, *Ph. (Ph.) globosa* and *Lilljeborgi*). Seen from beneath it is oval, with its greatest breadth at about the middle, the anterior and the posterior ends rather broadly (more so than in *Ph. (Ph.) globosa*, for instance; cf. the figure for this species) and almost symmetrically rounded; its side contours are uniformly arched. Surface of the shell: This has no marked sculpture; in transmitted light it appears to be rather finely and irregularly reticulate (cf. fig. 2); in reflected light each mesh seems to correspond to a rather shallow cavity. It is sparsely furnished with moderately long, scattered bristles, which are characterized by suddenly becoming narrower from a rather broad basal part (their type is about the same as the long bristle in fig. 4 of *Ph. (Ph.) globosa*). The pores of the surface are rather small and numerous and very difficult to observe with certainty. Seen from inside: Medial bristles: The bristles on the rostrum are about as numerous as on *Ph. (Ph.) Lilljeborgi*; most of them seem not to have any long hairs distally. Posteriorly on the list there are a moderate number of bristles, partly arranged in small groups. Between the posterior part of the list and the margin of the shell there are a few short bristles. On the other hand there is at this place no such pocket as has been given as characteristic of *Ph. (Ph.) Lilljeborgi*. The rostral selvage has rather short marginal hairs.

First antenna (fig. 3): — This agrees in its details with this antenna of *Ph. (Ph.) globosa*. No variation was observed in the number of sensorial filaments on the end bristles. There are rather abundant hairs on the second joint, and short, stiff hairs were also observed on the first joint, especially ventrally.

Second antenna: — Exopodite: This is very like that of *Ph. (Ph.) globosa*. The bristles on the second to the fourth joints are about as long as the first joint. In females with large eggs in the brood chamber the long natatory bristles were broken off as in the species just mentioned. The endopodite is also very like that of *Ph. (Ph.) globosa*. Sometimes a rather short bristle, with short hairs, may be found somewhat distally of the long ventral bristle on the second joint. The distal bristle on this joint is perhaps somewhat more pointed than in *Ph. (Ph.) globosa*.

Mandible: — Protopodite: Basale: This has from seven to nine bristles ventrally, some of which are rather long and some of moderate length. Apart from the two

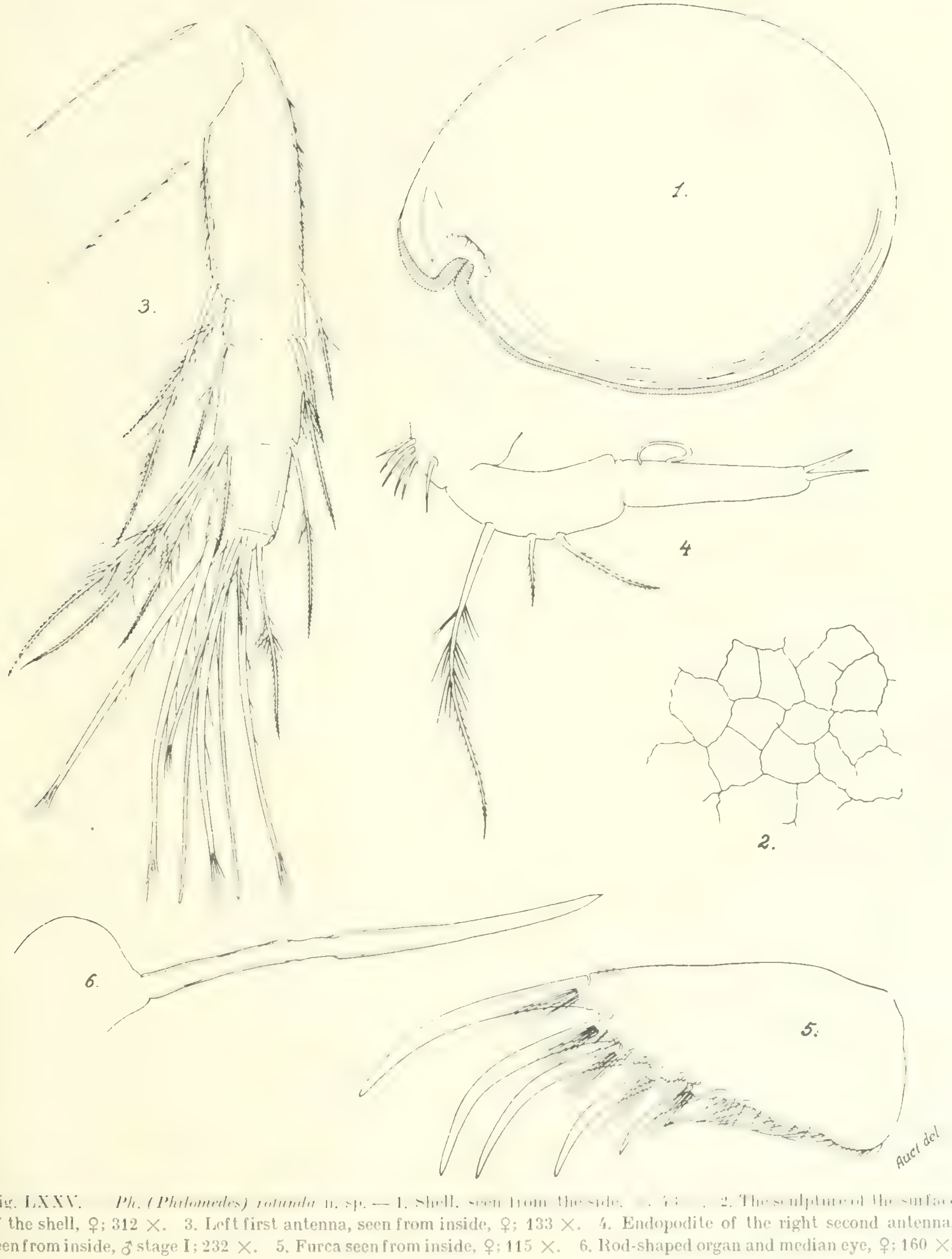

Fig. LXXV. *Ph. (Philomedes) rotunda* n. sp. — 1. Shell, seen from the side, [illegible]. 2. The sculpture of the surface of the shell, ♀; 312 ×. 3. Left first antenna, seen from inside, ♀; 133 ×. 4. Endopodite of the right second antenna, seen from inside, ♂ stage I; 232 ×. 5. Furca seen from inside, ♀; 115 ×. 6. Rod-shaped organ and median eye, ♀; 160 ×.

distal bristles there is only one bristle dorsally, situated just in front of the middle of the joint; this bristle is about as long as this joint. The two distal bristles are somewhat different in length, somewhat longer or shorter than this joint. All three are of about the same type, with one or a few wreaths of long, stiff secondary bristles at the middle and short, fine hairs distally. The two bristles of the exopodite are somewhat shorter than the distal bristles on the second protopodite joint, but of about the same type as these. Endopodite: Of the four ventral bristles on the first joint the shortest one is about half as long as the second endopodite joint, the three others are about as long as this joint; they are all furnished at the middle with one or a few wreaths of long, stiff secondary bristles and with short hairs distally. Second endopodite joint: The anterior proximal group of bristles comprises three bristles, of which the medial ones are somewhat shorter than the lateral one, the latter being about half as long as this joint; all of them are usually furnished with short, fine hairs. End joint: The longest middle claw is about as long as the second endopodite joint. The anterior claw is only about a third of this length. The weak anterior bristle in this species is somewhat longer than the anterior claw. Pilosity: The second protopodite joint and the second endopodite joint have groups of short, fine, stiff hairs on the outside; similar hairs are also found distally-anteriorly on the first endopodite joint.

Maxilla: — This is very like this limb in *Ph. (Ph.) globosa.* Protopodite: The bristle on the anterior side of the palp on the boundary between the protopodite and the endopodite is long, being about as long as the endopodite, and has no long secondary bristles. Endopodite: This has four or five bristles on the first joint distally-posteriorly. The end joint has three or four c-bristles; the powerful bristles among the b- and d-bristles have a very weak equipment, almost smooth.

Fifth limb: — This is very like the corresponding appendage in *Ph. (Ph.) globosa.* In one specimen three bristles were observed on the outer lobe of the third exopodite joint on this limb of one side.

Sixth limb: — Very like that of *Ph. (Ph.) globosa.* The second exopodite joint has, on the average, somewhat more numerous bristles.

Seventh limb (fig. 7): — This has about the same relative length as in *Ph. (Ph.) globosa.* Cleaning bristles: These are rather numerous, 23—26 being observed; in most cases, as in *Ph. (Ph.) Lilljeborgi,* three dorsal ones and two ventral ones are situated close together distally, sometimes three dorsal ones and three ventral ones were observed; the rest are scattered irregularly proximally of the former ones, being in most cases somewhat more numerous on the dorsal side of the limb. They are of moderate and somewhat varying length, and are furnished with from two to five bells, cut off transversally distally; the tongue of the distal bell is also cut off transversally. Proximally of the bells the cleaning bristles are furnished with from one to five wreaths of short, stiff hairs, placed obliquely. The end comb (fig. 8) consists of about twelve to sixteen teeth of moderate strength and length, decreasing somewhat in length the more proximally they are situated. These teeth are furnished proximally on each side with a rather strong secondary tooth and are rounded distally; there are no wing-shaped processes at the sides (such as are found, for instance, in *Ph. (Ph.) globosa* and *Lilljeborgi*), or if they do exist,

they are very weak and have no free points. The cavity situated dorsally of the end comb is rather deep and is furnished dorsally with three moderately long, claviform, smooth, chitinous pegs (fig. 8).

F u r c a (fig. 5): — This has ten claws, diminishing in length posteriorly, without any clear division into main claws and secondary claws. Claws nos. 2 to 4 are rather decidedly bent; this bending varies, however, to some extent. The five anterior claws have a proximal-medial group of long, stiff bristles, the posterior ones have no such bristles. Medially close to

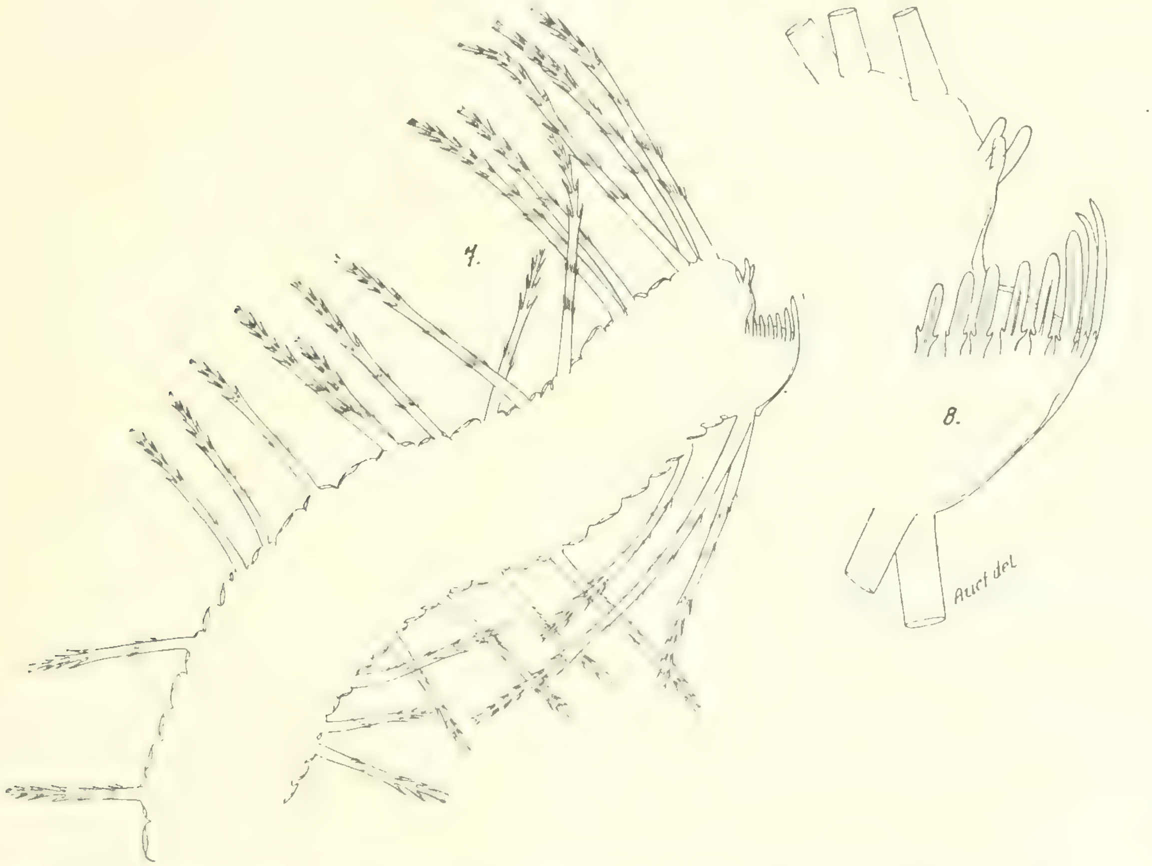

Fig. LXXVI. — *Ph. (Philomedes) rotunda* n. sp., ♀. — 7. Seventh limb; 248 ×. 8. Distal part of this limb; the bristles are broken; 680 ×.

the claws there are on the lamellae sparsely scattered stiff bristles varying in length and number. In front of the first claw and behind the posterior one the lamellae are furnished with short, fine hairs; apart from these they are most frequently quite smooth.

R o d - s h a p e d o r g a n (fig. 6): — This organ is about 0,5 mm. long. It is finely pointed distally. Somewhat proximally of the middle of the organ a rather considerable portion of it is thin-walled; at this part the organ is flexible. There is no division into joints at all. It is smooth.

The m a l e is unknown.

R[illegible] Ph. (Ph.) [illegible] Da[illegible]

Remarks: — It is impossible to decide for certain whether this species is identical with *Ph. (Ph.) laevipes*, though it does not seem impossible. As a preliminary I considered it best to describe it as a new species. The description of *Ph. laevipes* that is found in E. von DADAY, 1908, p. 12 is exceedingly deficient, clearly drawn up without the author having the necessary knowledge of the forms belonging to this sub-genus.

Ph. [illegible] D[illegible]

In passing I may point out that *Ph. laevipes* is probably a larva of the species *Ph. Charcoti*, which is described by E. von DADAY in the same treatise. DADAY himself indicates the possibility of these two forms being identical. Thus we read on p. 15 of this treatise: „En général, les particularités de l'organism rappellent beaucoup la *Philomedes Charcoti*, et, si la structure des pattes vermiformes ne différait pas autant, on pourrait réunir les deux espèces, vu que toutes deux sont du même endroit „(la côte de l'île Booth-Wandel, Terre de Graham, Antarctis)", encore que capturées à des dates différentes." According to this author the seventh limb of *Ph. laevipes* is, unlike that of *Ph. Charcoti*, quite bare. This character to which DADAY attached such great importance that he derived the name of the species from it, can, of course, not be regarded as any reason for not identifying these species. It is known that this absence of armature on the seventh limb is a character of the larva; all species of this genus seem to have a seventh limb of this type during the third larval stage. Other characters as well, such as the length of the shell, the number of furcal claws, etc. support the idea that *Ph. laevipes* is a larva of *Ph. Charcoti* in the third stage.

The form dealt with by me here seems to differ from *Ph. Charcoti*, of which only the male is described, in at least one character, namely the number of bristles on the seventh limb. *Ph. Charcoti* is said to have only thirteen bristles, six on one side and seven on the other, while *Ph. (Ph.) rotunda* is characterized, as we have seen above, by having a somewhat larger number (23—26).

R[illegible] Ph. (Ph.) [illegible] Brady.

Another species to which *Ph. rotunda* is certainly very closely related is *Ph. (Ph.) orbicularis* — which, curiously enough and certainly incorrectly, is regarded by its author, G. S. BRADY, as a southern variety of *Ph. (Ph.) globosa* — „It is in all respects very similar to the well-known European species *P. Brenda*" *(globosa)* „and may perhaps be fairly looked upon as a southern variation of that form". G. S. BRADY's description is unfortunately too incomplete to permit of a certain identification. The relatively great length of the shell (2.5 mm.) and the fact that „the surface of the shell is smooth and densely clothed with a villous coating of very short hairs" (G. S. BRADY, 1907, p. 4) seem, however, to argue against the identity of these forms. It is, however, not impossible that they are identical, nor can it be considered impossible that G. W. MÜLLER was right when in 1912 he identified *Ph. orbicularis* with *Ph. laevipes*.

Habitat: — South Georgia: S. A. E., Station 18, mouth of the West Fiord, Cumberland Bay, lat. 54° 15′ S., long. 36° 25′ W.; 22. IV. 1902; depth, 250 m.; loose clay; temperature at the bottom — 1.2° C: 1 mature female; R. M. S. 136. S. A. E., Station 22, off May Bay, lat. 54° 17′ S., long. 36° 28′ W. (type locality); 14. V. 1902; depth, 75 m.; clay with scattered algae; temperature at the bottom + 1.5° C: 1 mature female; R. M. S., on slides. S. A. E., Station 23, off the mouth of Morän Fiord, lat. 54° 23′ S., long. 36° 26′ W.; 16. V. 1902;

depth, 64—74 m.; grey clay with gravel and stones; temperature at the bottom + 1,65° C: 4 mature females and 14 larvae; R. M. S. 137. S. A. E., Station 24, off Grytviken, lat. 54° 22′ S., long. 36° 27′ W.; 20. V. 1902; depth, 95 m.; clay: 2 juvenes; R. M. S. 138. S. A. E., Station 30, Morän Fiord, lat. 54° 24′ S., long. 36° 26′ W.; 26. V. 1902; depth, 125 m.; clay with scattered stones; temperature at the bottom — 0,25° C: 1 mature female; R. M. S., on slides.

Type-specimen, on slides, R. M. S.

Sub-genus Scleroconcha n. sub-gen.

Philomedes (part.), autorum.

Diagnosis: — See above p. 380.

Remark: — For the number of species see above, p. 380.

Sub-genotype is *Ph. (Scl.) Appellöfi* n. sp.

Ph. (Scleroconcha) Appellöfi* n. sp.

Description: — Female: —

Shell: — Length, 3,3—3,6 mm.; length : height about 1,5 : 1; length : breadth about 2 : 1. Seen from the side (fig. 1) it varies, though only slightly, in shape. It is somewhat sub-rhomboidal with its greatest height at about the middle. The dorsal and ventral margins are boldly arched. The former is somewhat irregular, its posterior part is sometimes more flattened than is shown in the accompanying figure and with a distinct corner marked off from the posterior margin of the shell. The ventral margin is uniformly curved, passing without any corner into the posterior margin of the shell. The posterior part of the shell is drawn out into a strongly projecting, rounded beak-like process somewhat ventrally of half the height of the shell. The rostrum has a strongly projecting, rounded anterior corner; when the shell is seen from the side, the ventral margin of the rostrum is covered by a strongly projecting, powerful process, somewhat rounded distally (cf. fig. 3). The incisur is broad, almost rectangular, and is marked off from the ventral margin of the shell by a rather large and somewhat bifurcated protuberance. Seen from beneath (fig. 2) the shell has almost parallel sides anteriorly and posteriorly converging irregularly and suddenly towards the anterior and posterior points. The surface of the shell has a powerful, decorative sculpture: partly four strongly projecting longitudinal ridges, and also numerous irregular foveolae of moderate depth and size, situated close together. Of the four ridges two, one dorsal one and one ventral one, run close to the margin of the shell, which they cover to a great extent when the shell is seen from the side; the dorsal one splits about half-way along the shell into two ridges running close to each

* This species is called after my esteemed teacher, Professor A. Appellöf.

other and almost parallel, both continuing down to the rostrum. The two other ridges run more parallel to the longitudinal axis of the shell, one somewhat above, the other somewhat below half the height of the shell. The former continues anteriorly to the rostrum, where in most cases it joins the dorsal ridge; posteriorly it joins the ridge that runs along the ventral margin on the posterior beak-like process of the shell; the anterior part of this ridge is weakly and fairly uniformly curved dorsally; behind the middle of the shell, on the other hand, it is very irregular with at least two very striking, nodose, projecting corners. The latter, the ventral one of the ridges that run more parallel to the longitudinal axis of the shell, is almost straight and suddenly comes to an end posteriorly a short distance in front of the posterior beak of the shell with a rather strongly projecting protuberance; anteriorly just behind the rostral incisur it is joined by means of a low but distinct transverse ridge both to the ridge running most dorsally to it and to the

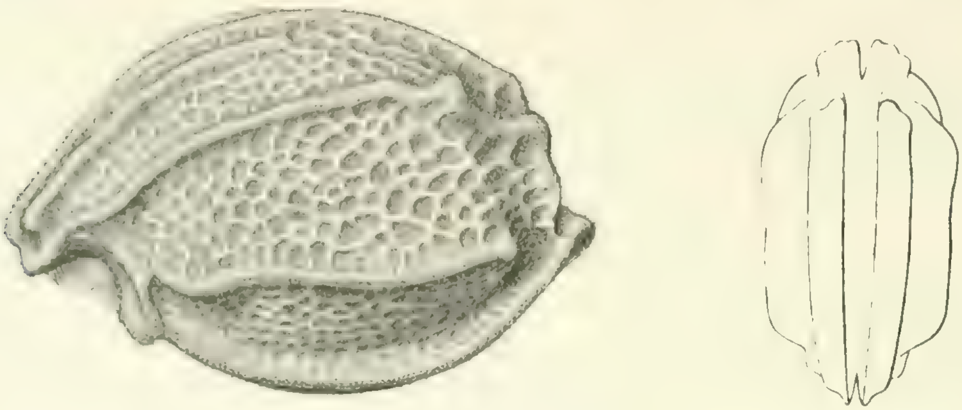

Fig. LXXVII. — *Ph. (Scleroconcha) Appellöfi* n. sp., ♀. — 1. Left valve seen from the side (in reflected light); 23 ×. 2. Shell seen from below; 14,5 ×.

ridge that runs along the ventral margin. The foveolae are sometimes considerably less developed than is shown in the accompanying figure. The ridges, like the bottoms of the foveolae, have a sculpture with small cavities, sometimes very difficult to observe (in some cases not even existing?). The surface of the shell is sparsely furnished with small hairs, more numerous and somewhat longer near the margin of the shell. Pores of the surface are found to a moderate number; they are small and difficult to observe. S e e n f r o m i n s i d e the posterior beak-like process appears to be slightly hollowed out in the shape of a siphon. Medial bristles: The row of bristles on the rostrum is rather sparse; a number of bristles in this row do not seem to have any long distal secondary bristles. The bristles on the posterior portion of the list are difficult to observe with certainty; they seem to exist in moderate number and not to be arranged in clear groups. Between the list and the posterior margin of the shell no bristles seem to occur, nor is any pocket-like formation observable here.

F i r s t a n t e n n a (fig. 4): — Of the three bristles on the second joint the posterior one is the longest, being in most cases about as long as the total length of the third to the fifth or the third to the sixth joints; the lateral one is the shortest, in most cases about as long as the total length of the third and fourth joints. The third joint has two anterior bristles and one

Fig. LXXVIII. — *Ph. (Scleroconcha) Appellöfi* n. sp. 3. Rostrum of the right valve seen from inside, [illegible] 82 ×. 4. Right first antenna seen from inside, ♀; 80 ×. 5. Distal part of the left first antenna, seen from inside, ♀; 160 × 6. Endopodite of the left second antenna seen from inside, [illegible] 160 ×. 7. Endopodite of the [illegible] second antenna seen from inside, ♂ stage I. 132 [illegible]

posterior bristle. Of the two anterior ones, which are situated somewhat distally of the middle of the joint, the anterior one is often somewhat longer than the other and about as long as the total length of the third and fourth joints. The posterior bristle on this joint is in most cases about as long as the shorter of the two anterior ones. The fourth joint has two anterior and four posterior bristles. The latter are of about the same relative length as in *Ph. (Ph.) globosa*; the two anterior ones are in most cases about as long as or somewhat longer than the two anterior bristles on the preceding joint. The bristle on the fifth joint and the a-bristle on the end joint are subequal, their length being about the same as the total length of the fourth and fifth or the fourth to the sixth joints. The length of the bristles discussed so far varies somewhat, though only slightly; their equipment is usually two to four irregular wreaths of long, stiff secondary bristles. The sensory bristles on the end joint (fig. 5) have the following equipment: the b-bristle has two proximal and three distal sensorial filaments; the c-bristles have seven proximal and four distal sensorial filaments; the f- and g-bristles have six proximal and four distal sensorial filaments. Pilosity: The second to the fifth joints have rather abundant transverse groups of short, stiff hairs.

Second antenna: — Exopodite: This is very like that of *Ph. (Ph.) globosa.* The proportion between the length of the first joint and the length of all the succeeding joints is about the same as in *Ph. (Ph.) Lilljeborgi.* The bristles on the second to the fourth joints are about as long as the two to three proximal joints, bare, and finish distally as two short, fine points. In females with large eggs in the brood chamber the long natatory bristles are broken off in the same way as in *Ph. (Ph.) globosa.* There are no basal spines, but a number of hairs in the distal rows of hairs on the second to the eighth joints are considerably strengthened and are like spines at the place where in other species the basal spine is to be found. Endopodite (fig. 6): The first joint is very similar to that of *Ph. (Ph.) globosa.* The second joint is rather short; ventrally it has only one bristle, situated somewhat proximally of the middle of the joint. This bristle has numerous wreaths of long, stiff secondary bristles at the middle and short hairs distally and is exceedingly long, almost as long as the protopodite of this antenna. In one specimen (the type-specimen) there was observed on the antenna of one side, somewhat distally of this bristle, an additional bristle of about the same length and type as the bristles on the first joint. The distal bristle of the second joint is about as long as or somewhat shorter than this joint; it is rather pointed distally.

Mandible (fig. 8): — Protopodite: The basale has ventrally ten to twelve, usually ten, bristles of different lengths, some moderately long, some, especially among the distal ones, rather long. Dorsally this joint has, apart from the two distal bristles, only one bristle, situated somewhat in front of the middle of the joint; the latter bristle is about as long as this joint, the two distal bristles differ somewhat in length, the longest being about as long as the dorsal side of this joint or even somewhat longer; these bristles have one or a few wreaths of long, stiff bristles at the middle and fine, short hairs distally; sometimes the proximo-dorsal bristle has no wreath. The two bristles of the exopodite are of about the same type and length as the two distal bristles on the second protopodite joint, sometimes they are rather longer, sometimes a little shorter. Endopodite (fig. 11): The four ventral bristles

on the first joint are all of about the same type, with one or more wreaths of long, stiff secondary bristles at the middle and short, fine hairs distally. Three of

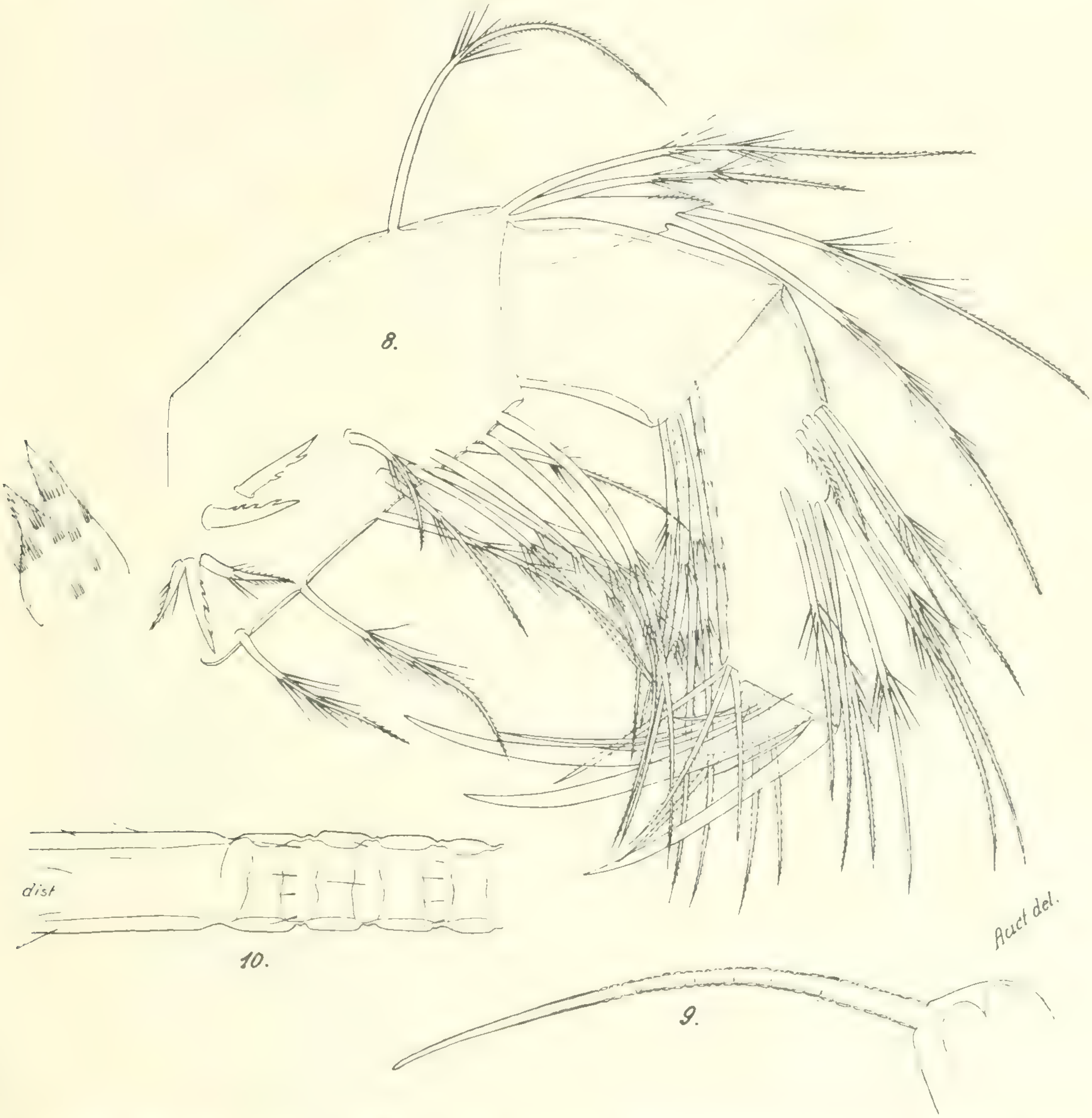

Fig. LXXIX. — *Ph. (Scleroconcha) Appellofi* n. sp., ♀. — 8. Left mandible seen from inside; 162 ×. 9. Median eye and rod-shaped organ; 110 ×. 10. A part of the rod-shaped organ at the boundary between the jointed and the unjointed portion; 708 ×.

these bristles are subequal, somewhat longer than the anterior side of the second endopodite joint; the fourth is somewhat shorter. Second joint: The proximo-anterior group of bristles contains four bristles, the inner one of which is rather short and rather

coarsely pectinated; the one situated nearest this is somewhat longer and finely pectinated; the two others are considerably longer than the former ones, the lateral one, which is the longest, being almost as long as the posterior side of the joint; of the two latter ones the inner one has short hairs, the outer one has short hairs distally and usually a wreath

Fig. LXXX. — *Pt. ([illegible]) [illegible]* n. sp. — 11. The two [illegible] endopodite joints of the right mandible seen from inside; 240 ×.

of long, stiff secondary bristles at the middle. End joint: The longest middle claw is almost as long as the second endopodite joint. The anterior claw is in most cases somewhat longer than half the long middle claw. Pilosity: The second protopodite joint and the second endopodite joint have groups of short, stiff hairs on the inside; the first endopodite joint has a row of similar hairs distally-anteriorly.

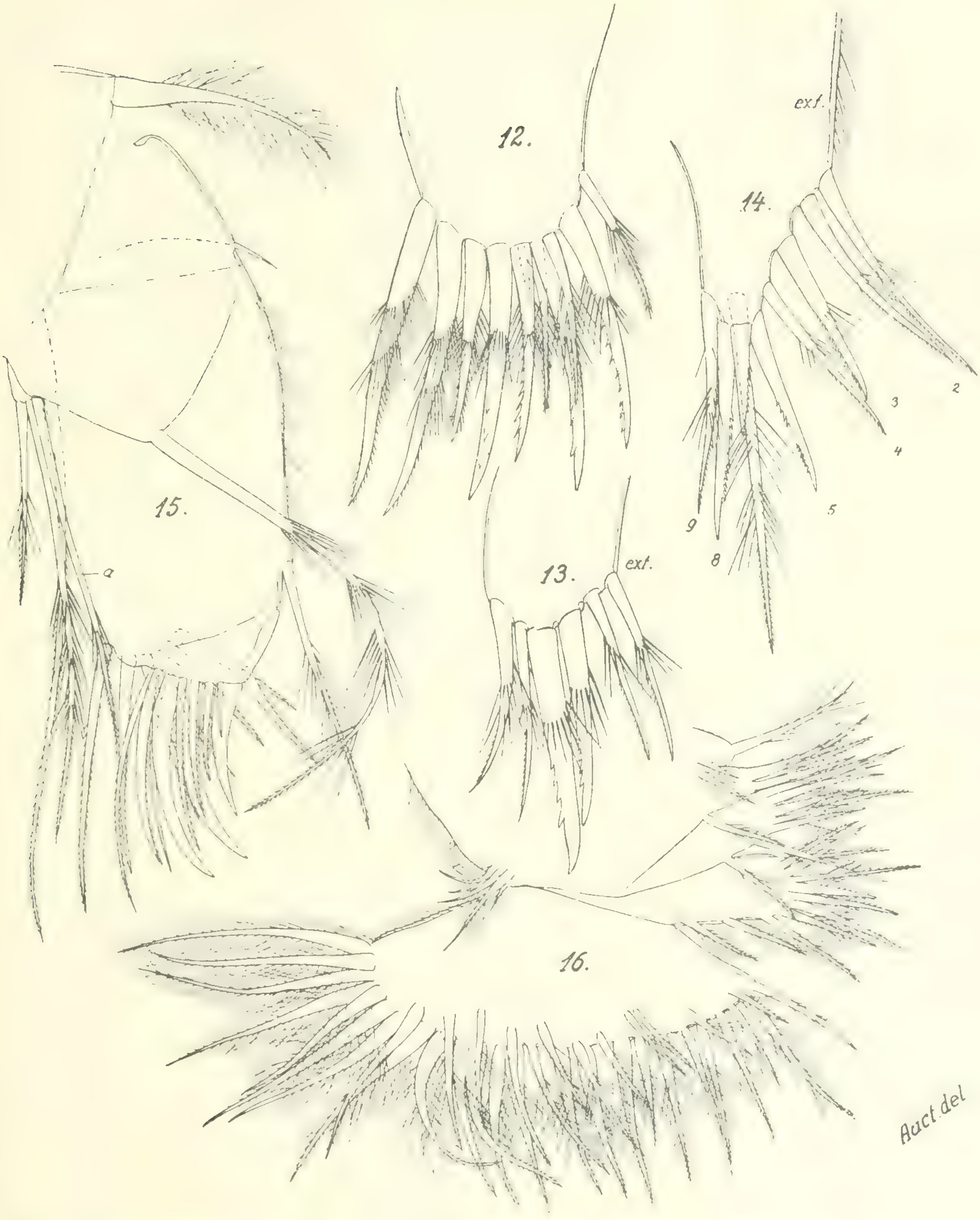

Fig. LXXXI. — *Ph. (Scleroconcha) Appellöfi* n. sp., ♀. — 12. First endite of the maxilla; 250 ×. 13. Second endite of the maxilla; 250 ×. 14. Third endite of the maxilla; 250 ×. 15. Endopodite of the left maxilla seen from inside; 200 ×. 16. Left sixth limb seen from inside; 110 ×.

M a x i l l a: — This is very like the corresponding appendage in *Ph. (Ph.) globosa.* P r o t o p o d i t e: First endite (fig. 12): This has eleven distal bristles; in one specimen as many as twelve were observed on the maxilla of one side, on another only nine, but in the latter case it seemed probable that one or more bristles had been broken off. The extra bristle was placed close to the short one and was somewhat shorter and weaker than the powerful bristles; it had a wreath of long, stiff secondary bristles at the middle and was fairly strongly pectinated distally. In the case of twelve bristles the two extra bristles were of the type just described. Second endite see fig. 13. The third endite (fig. 14) has nine bristles. As in *Ph. (Ph.) globosa*, the equipment of the bristles, especially the distal ones, and the number and strength of the secondary teeth are subject to variation. The bristle on the anterior side of the palp at the boundary between the protopodite and the endopodite is very short and almost bare. E x o p o d i t e (fig. 15): The equipment of the three bristles varies; one of the long ones often has no long secondary bristles. E n d o p o d i t e (fig. 15): End joint: This has usually three a-bristles and three or four, usually three, c-bristles; the powerful b- and d-bristles are almost bare.

F i f t h l i m b: — This is very like the type described for *Ph. (Ph.) globosa.* P r o t o p o d i t e: First endite (fig. 17): The anterior and the posterior bristle are in most cases somewhat shorter than in the species just mentioned and have no long secondary bristles. The second endite (fig. 18) has only seven, the third (fig. 19) only eleven bristles. E x o p o d i t e: The anterior constituent tooth of the main tooth (fig. 20), like the tooth-like protuberance situated at its base, is less clumsy than in the species mentioned. The bristles on the anterior and posterior edges of the main tooth are subequal and of moderate length and strength; there is sometimes a wreath of long, stiff secondary bristles at the middle of all three; sometimes the bristle situated behind the main tooth has no such wreath. Second joint (fig. 22): One of the outer bristles in the group of three bristles is relatively long, being about two-thirds or three-quarters of the length of the long middle bristle. Third joint: Of the two bristles on the outer lobe one is relatively short and weak, being only about half as long as the other. The shorter of these two bristles has a few long, stiff secondary bristles at the middle, the other has a few wreaths of similar bristles. In one specimen four bristles were observed on the inner lobe of this joint on the limb of one side.

S i x t h l i m b (fig. 16): — This is very like that of *Ph. (Ph.) globosa.* We may add: Of the two medial bristles on the first endite of the protopodite one is short, the other usually moderately long. The endite on the first joint of the exopodite has one or two medial bristles and from eight to ten distal bristles. The second exopodite joint has 32—36 bristles distally.

S e v e n t h l i m b (fig. 23): — This is about half the length of the shell. The cleaning bristles (fig. 24) are comparatively few in number, only ten to twelve being observed; of these three dorsal ones and three ventral ones are placed closely together distally, and from four to six, two or three on each side, are scattered somewhat proximally of the former ones. Some of the distal bristles are rather long, the others are of moderate and somewhat varying length. On the long bristles there are about six to ten, on the shorter ones two to six, bells cut off transversally distally; the tongue of the distal bell is also cut off transversally distally. Proximally of the

Fig. LXXXII. — *Ph. (Scleroconcha) Appellöfi* n. sp., [illegible] — Fifth limb. 17. First endite of the protopodite; 312 ×. 18. Second endite of the protopodite, somewhat compressed; 312 ×. 19. Third endite of the protopodite, somewhat compressed; 312 ×. 20. Main tooth of the first exopodite joint, with the adjacent bristles; 312 ×. 21. A part of the third endite of the protopodite and the two proximal exopodite joints seen from the front; on the third endite only the two anterior bristles are drawn; on the main tooth only two constituent teeth are to be seen; on the second exopodite joint the d-bristle is to be observed; 312 ×. 22. The three distal exopodite joints seen from behind; 312 ×.

bells the cleaning bristles are furnished along the greater part of their length with dense, short, fine, stiff hairs, arranged into from about two to five wreaths. The end comb (fig. 25) is rather weak and consists of about seven or eight subequal teeth of moderate length. These teeth are rounded distally and are furnished on both sides with from one to three weak secondary teeth. The cavity dorsally of the end comb is shallow, furnished at about the middle with a chitinous peg of about the same type and size as the teeth of the end comb (fig. 25).

F u r c a (figs. 26—29): — This has from thirteen to fifteen claws; sometimes the same number is found on both lamellae, somtimes it is different; the combinations 15—15, 15—14 and 15—13 were observed. Claws nos. 1, 2 and 4 are powerful, claw no. 3 is somewhat shorter and rather considerably weaker than no. 4. From claw no. 5, which is pretty considerably shorter and weaker than no. 4, the following claws decrease fairly uniformly in length and strength the more posteriorly they are situated. On claw no. 3 the secondary teeth extend in most cases right to the point. On the two distal claws there is basally-medially a group of rather long, stiff bristles; these bristles are in most cases rather weakly developed and sometimes seem even to be missing on claw no. 2. On the following claws there are no such bristles at all. On the inside of the furcal lamellae there is at the base of the claws a rather abundant supply of fairly long, stiff bristles varying in length, in most cases without any evident arrangement in groups. In addition there are at this part copious short, fine hairs more or less clearly arranged in groups of something like rows; behind the claws the lamellae have fine hairs. The pilosity is subject to variation.

The length of the r o d - s h a p e d o r g a n (figs. 9 and 10) is about 0,7 mm.; its proximal two-thirds is segmented; distally it is either finely pointed or rounded. It has sparse, short, scattered hairs.

The m a l e is unknown.

Habitat: — S o u t h G e o r g i a: S. A. E., Station 20, Antarctic Bay, lat. 54° 12′ S., long. 36° 50′ W.; 6. V. 1902; depth, 250 m.; small stones; R. M. S. 139. S. A. E., Station 22, off May Bay, lat. 54° 17′ S., long. 36° 28′ W. (t y p e l o c a l i t y); 14. V. 1902; depth, 75 m.; clay with scattered algae; temperature at the bottom, + 1.5° C; R. M. S. 140. S. A. E., Station 24, off Grytviken, lat. 54° 22′ S., long. 36° 27′ W.; 20. V. 1902; depth, 95 m.; clay; R. M. S. 141. S. A. E., Station 30, Morän Fiord, lat. 54° 24′ S., long. 36° 26′ W.; 26. V. 1902; depth, 125 m.; clay with scattered stones; temperature at the bottom, — 0,25° C; R. M. S. 142. At these stations twenty or thirty specimens were captured in all, mature females and juvenes in different stages.

S. A. E., Station 6, S.W. of Snow Hill Island, lat. 64° 36′ S., long. 57° 42′ W.; 20. I. 1902; depth 125 m.; stones and gravel; one specimen, a larva, presumably belonging to this species, was captured; unfortunately it was too young for certainty of identification; R. M. S. 143.

Type-specimen on slides in the collections of the R. M. S.

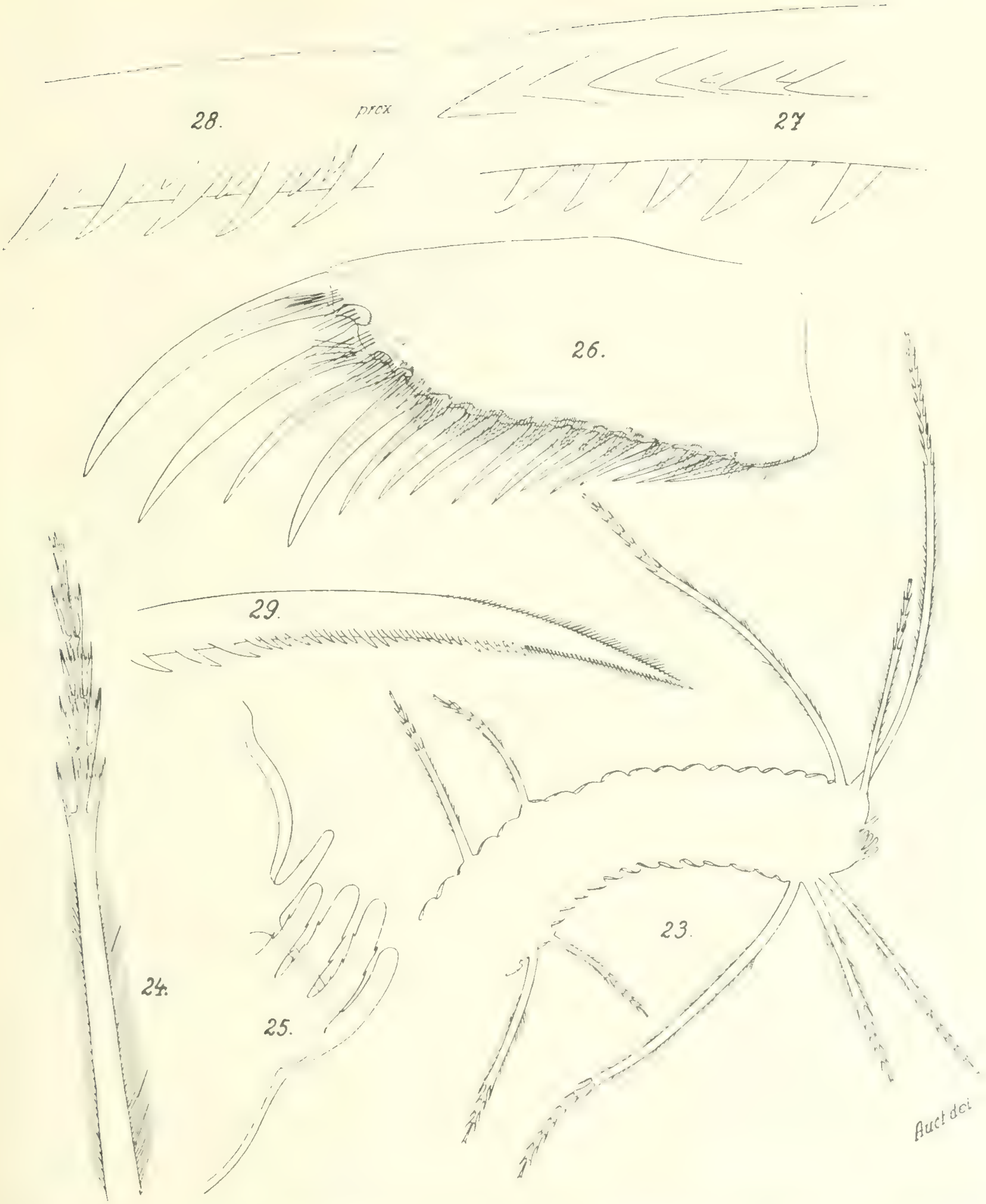

Fig. LXXXIII. — *Ph. (Scleroconcha) Appellofi* n. sp., ♀. — 23. Seventh limb; 166 ×. 24. Distal part of a cleaning bristle of this limb; 708 ×. 25. The end comb of this limb; 1045 ×. 26. Furca seen from within; 160 ×. 27. The middle portion of the first claw of the right lamella, seen from inside; 500 ×. 28. The middle portion of the first claw of the left lamella seen from outside; 500 ×. 29. The distal two-thirds of the fifth claw seen from outside; 500 ×.

Family Asteropidae.

Fam. *Asteropidae*, G. S. BRADY and A. M. NORMAN, 1896, p. 628.
Sub-Fam. *Cylindroleberinae*, G. W. MÜLLER, 1906 b, p. 32.
„ „ *Asteropinae*, G. W. MÜLLER, 1912, p. 42.

Description: — S h e l l: — This shows sexual dimorphism. — It has a well-developed rostrum. The incisur is rather deep; in most cases, the inner (posterior) part of the upper incisur lip covers the inner part of the lower incisur lip, with which it is also united at its innermost part. (This is expressed by G. O. SARS, 1887, p. 186 as follows: The rostral incisur „er nedentil begraendset af en indad skraat fremspringende, staerkt chitiniseret Lamelle".) The selvage varies in type, sometimes being rather broad, with a smooth margin, sometimes almost quite absent or divided into fine, short hairs. The list runs in an even closed bow from the rostral incisur along the ventral and posterior margins of the shell, coming to an end posteriorly near the hinge of the shell; it is in most cases narrow along the ventral margin of the shell, and somewhat wider inside the posterior margin of the shell. The distance from the list to the margin of the shell is on the average somewhat greater along the posterior margin of the shell than along the ventral margin. The valves are always joined along less than half the circumference. Contrary to the females, the males are always characterized by a ring of long hairs round the posterior part of the shell; in some forms, however, this wreath of hair is very sparse.

F i r s t a n t e n n a: — This shows rather strong sexual dimorphism. — The sensory bristle of the fifth joint is always developed. The original sixth joint has always only one bristle, situated distally-medially. This antenna has six or seven bristles distally, three of which are probably to be considered as belonging to the original seventh joint, and from three to four probably belong to the original eighth joint. In most cases, perhaps always, the anterior end bristle is claw-shaped.

S e c o n d a n t e n n a: — This shows dimorphism. — The e n d o p o d i t e in the female is small and weak, in the male it is always developed as a three-jointed clasping organ; the end joint of this branch has only one bristle, fixed distally in the females, proximo-ventrally in the males.

M a n d i b l e: — This has rather slight sexual dimorphism (sometimes even none at all?). — The p r o t o p o d i t e joints, like the two proximal e n d o p o d i t e joints, are

always large and well developed, the end joint of the endopodite is, on the other hand, comparatively small; the exopodite is more or less strongly reduced, but is always distinctly developed. Protopodite: The endite of the coxale: This is always well developed both in the male and the female. It is comparatively large, but it is certain, all the same, that it can not be used for mastication. It is bifurcated, but the two points are so close to each other that at first sight it seems to be undivided. Its dorsal point is differentiated into a hyaline, rather long, narrow, flexible and somewhat scythe-shaped process, which is compressed from the sides like a lamella and is directed towards the mouth. Its ventral point is considerably shorter and is rather narrow. The second protopodite joint is differentiated proximo-medio-ventrally into a conical process, which is armed with bristles and points towards the mouth. The exopodite has two bristles, situated ventero-distally, and in most cases very short. There are always a large number of glands emerging on the exopodite. Endopodite: This is always three-jointed, its end joint has a somewhat varying number of bristles.

Maxilla: — This has no (or sometimes very slight?) sexual dimorphism. — It is of a very strange type, differing greatly from all other Ostracods so far known; see fig. III: 4. It is not developed as a masticatory organ. It is moderately large, but rather weak, with weak chitinization and a rather weakly developed muscular system. It seems, like this limb in *Cypridinidae*, to have had five joints originally, three protopodite and two endopodite joints, but it has now only a slight indication of division into joints or even sometimes no division at all. The three joints of the protopodite always seem to be quite united; the boundary between the protopodite and the endopodite, like the boundary between the two endopodite joints, often seems, on the contrary, to be more or less perceptible. — Protopodite: The procoxale and the coxale are rather voluminous, but presumably rather short. The basale, which, like the two preceding joints, is directed forward and somewhat outward, seems, on the other hand, (contrary to what is the case in other known forms) to be comparatively long; it grows somewhat narrow distally and is somewhat arched in two planes, partly downwards and partly — like the procoxale and the coxale — inwards. On the procoxale and the coxale there are reduced endites, which are certainly quite useless for breaking up food; there are no endites on the basale. Latero-ventrally along the whole length of the protopodite there runs a rather strong chitinous list, coming to an end posteriorly on the medial side of the limb just behind the proximal endite, after having curved round the proximo-ventral part of the protopodite. From this list issues a very dense series of homogeneous bristles pointing ventrally and situated close together — almost like the plates of baleen of a baleen whale. These bristles are rather long and stiff, comparatively narrow and not annulated; they decrease fairly uniformly in length from front to back. The posterior bristle in this series differs somewhat in type. The protopodite always seems to have an epipodial appendage dorsally. There never seems to be any trace of an exopodite or else it is represented by a single bristle or a small group of bristles situated distally-laterally-ventrally on the basale. The endopodite is rather short, in most cases considerably shorter than the basale; it points downwards and when at rest is almost at right angles to the protopodite; it becomes narrow towards the point. The first endopodite joint is rather well developed, somewhat elongated; the end joint is, on the other hand, very short.

With regard to the differences between the previous authors' interpretations of the different parts of this limb and that which is followed in this work, see above pp. 33 and 36.

F i f t h l i m b: — This has no (or sometimes very slight?) sexual dimorphism. — Like the preceding limb it has a very peculiar type of structure, very different from all other O s t r a c o d s; see fig. IV: 5. The p r o t o p o d i t e and the two proximal e x o p o d i t e joints are differentiated into a rather long, narrow, tongue-shaped and quite unjointed organ, strongly compressed from the sides. This organ is bent slightly inward, — in the same way as the protopodite of the maxilla, — pointing anteriorly and outwards and twisted so that its ventral edge is pointed obliquely downwards towards the maxilla. Along the ventral edge of this organ there is a dense series of moderately long or more or less short bristles. The distal part of the e x o p o d i t e is reduced, being only represented by one or a few bristles, more seldom by a small verruciform process laterally somewhat in front of the middle of the tongue-shaped organ formed by the protopodite and the two proximal exopodite joints. The e p i- p o d i a l a p p e n d a g e is supported by rather powerful chitinous lists, which end dorsally, as they do ventrally, in a strong, spine-like part. The ventral one of these spines forms the end, so to speak, of the tongue-like part posteriorly; it is not free, as one would be inclined to believe from the descriptions of previous writers, but is attached to the wall of the body along the whole of its dorsal side; cf. fig. 14 of *A. aberrata*.

With regard to the differences between the interpretations of the different parts of this limb that have already appeared in the literature and that accepted in the present work see above pp. 38—42.

S i x t h l i m b: — This has no (or sometimes very slight?) sexual dimorphism. — It is always rather large and rather considerably lengthened in the longitudinal direction of the body, lamelliform, quite unjointed, but in other respects it varies considerably in type.

S e v e n t h l i m b: — This has no or sometimes very slight sexual dimorphism. — It has from two to four end combs arranged in pairs. In other respects it varies considerably in type.

P e n i s: — This is small and is only weakly chitinized. Distally it is split into two lobes.

G i l l s: — These have no or only very slight sexual dimorphism. — Contrary to what is the case in all other known O s t r a c o d s* well-developed gills are found in this group. They consist of a number of lamellae, attached along the dorsal side of the posterior part of the body and arranged in two longitudinal rows separated by a narrow space. The lamellae are placed transversely, pointing backwards and upwards and, when the animal is seen from the side, they cover the greater part of the dorsal side of the back of the body. With regard to their fine structure they resemble the lamellae of the gills in the other closely-related Crustacean groups.

Special terminology: — F i r s t a n t e n n a: — The far-reaching resemblance shown by the end bristles, with regard to their number, position and type, to the end bristles on this limb in the family *Cypridinidae* can only be explained as real homology; on account of this I considered it best to make use of the same notation for this group as for the family just mentioned (cf. remark on genus *Asterope*, p. 462).

* *Cypridina Hilgendorfi*, G. W. MÜLLER, 1890, p. 228 is an exception.

M a n d i b l e: — The dorsal point of the endite on the first protopodite joint is called „the scythe-shaped process“, the ventral point the „rod-shaped process“. The conical process situated proximo-ventero-medially on the second protopodite joint („Rückwärts gerichteter Fortsatz“, G. W. MÜLLER, 1894, explanation of pl. 4, fig. 44, but not p. 203) is called „the backward pointing process“.

M a x i l l a: — The dense series of bristles situated latero-ventrally along the protopodite is called „the baleen“, the single bristle „the baleen bristle“.

F i f t h l i m b: — The narrow tongue-shaped organ formed by the protopodite and the two proximal endopodite joints is called „the comb“, its ventral bristles „the comb bristles“.

The description of the first representative of this group.

Historical: — The first description of a species belonging to this family that is found in literature is that of A. PHILIPPI in „A r c h i v f ü r N a t u r g e s c h i c h t e“, 1840, pp. 186 to 188. The species in question was pronounced by PHILIPPI to be a type of a new genus, *Asterope*, „der O s t r a c o p o d e n“, for he found that not only the shell, but „auch das Thier sowohl von *Cypris* and *Cytherina*“ (= *Cythere*, part.) „als auch von *Cypridina* MILNE-EDWARDS . . . so bedeutend verschieden ist, daß es nothwendig ein eigenes Genus bilden muß“. The new genus would differ from the genus *Cypridina* principally „1. durch den Einschnitt der Schale*, 2. indem nur zwei Paar blattartiger Füße vorhanden sind, 3. indem der Schwanz einfach ist (bei *Cypridina* besteht er aus zwei Lamellen)“. Thus entirely mistakes! Although the description is very incomplete and consists principally of mistakes, there can scarcely be any real doubt that the species in question — *A. elliptica* — is really very closely related to and belongs to the same genus as the forms that are included in the genus *Asterope* in the present work.

The genus Asterope was rejected in the beginning.

During the first three decades after 1840, however, PHILIPPI's new name for the genus did not gain recognition. The writers who dealt with forms belonging to this genus during this time referred them to other more or less closely related genera that had been previously described. Thus H. NICOLET (GAY, 1849, p. 294) describes a species that certainly belongs here under the name of *Cypris bimaculata*; J. D. DANA's *Cypridina olivacea*, 1849, p. 51 can — on account of the shape of the shell and the wreath of hairs round the back part of the shell — be referred to this genus, though with some doubt.** E. GRUBE, 1859, also refers forms belonging here to the genus *Cypridina*, and A. M. NORMAN, who adopts the generic name *Asterope* in his later works, in 1861 describes one of these species under the name of *Cypridina teres*, and later on, 1867, p. 198, includes it in the genus *Bradycinetus* (= *Philomedes*). None of these writers gives any reasons for this method of procedure of theirs. W. BAIRD, who consistently refers these forms to the genus *Cypridina* in all his works upon them, 1847, 1850 a and 1850 c, explains this, 1847, p. 21 by the fact that in dissecting two species, „which I can only refer to the genus *Cypridina*“, namely *C.* (= *Philomedes*) *Macandrei* and *C.* (= *Cyclasterope*?) *Adamsi*, he found that these

* Owing to an oversight MILNE EDWARDS, 1840, described the genus *Cypridina* without any [illegible].

** G. S. BRADY was the first to put forward the assumption that this species might be included in the genus *Asterope*, 1880, p. 154. This assumption was not accompanied, however, by any reasons; BRADY only writes „*Asterope olivacea* DANA“. In the same place this author writes *Cypridina mediterranea*, O. COSTA, 18[illegible] (= *Asterope mediterranea*). This view is of course incorrect; it was abandoned in G. S. BRADY's later work and was never adopted by other writers. *Cypridina olivacea* was referred to *Philomedes* by G. S. BRADY in 18[illegible].

were in several respects closely related to the genus *Cypridina*, in others to *Asterope*. „From this mixture of the characters of the two genera, and taking into consideration the minuteness of the parts examined, and the different appearance these same parts assume in different positions under different microscopes and with different observers, I am inclined to believe these two genera to be identical." In his work of 1850 a W. BAIRD says, p. 176, that he is following the authority of J. D. DANA in synonymizing these two genera; he writes: „fide DANA in literis".* Finally F. MÜLLER also uses the generic name *Cypridina* for species belonging here in his essay „Bemerkungen über *Cypridina*", 1870, a work which is to some extent rather meritorious and which is based on the dissection of three Cypridinids (one species belonging to the genus *Philomedes* and two species belonging to the family *Asteropidae*). This author writes on p. 255: „Ich behalte für alle drei, wie überhaupt für alle Muschelkrebse, die seitliche Augen und die bekannten „geringelten Anhänge" besitzen, den Namen *Cypridina* bei." F. MÜLLER explains this point of view by stating that the anatomy of all the species then described was too inadequately known to permit of a scientifically founded division of the forms belonging to this unit into smaller systematic units.

G. O. SARS, in his work of 1865, p. 100, points out that *Asterope* must be considered as a special genus, well distinguished from other Cypridinids.

G. S. BRADY, in his work 1868 a, p. 127, established a new genus *Cylindroleberis*, which included two species previously grouped under the genus *Cypridina*, *C. Mariae* W. BAIRD and *C. teres* A. M. NORMAN. BRADY did not, however, retain this new generic name long; already in his work of 1871 he identifies (p. 292) the genus *Cylindroleberis* with *Asterope* PHILIPPI and in all his subsequent works we only find the latter name. In spite of this a number of investigators who afterwards dealt with forms belonging to this unit have nevertheless retained the name *Cylindroleberis*, thus, for instance, G. W. MÜLLER in his works of 1893, 1894, 1906 b and 1908 (not 1890, where he uses the generic name *Asterope*), J. A. CUSHMAN, 1906, CH. JUDAY, 1907, R. W. SHARPE, 1909 and TH. STEBBING, 1910. The reason for this is to be found in the fact that in the same year (at the same time?) as A. PHILIPPI published his essay on the genus *Asterope* two other investigators (MÜLLER and TROSCHEL) described a new Echinoderm genus under the same name. As, however, according to modern nomenclature, the generic name *Asterope* cannot be used for the Echinoderm genus established by the two latter authors, this difficulty may be considered to have disappeared. Accordingly in the present work I considered it convenient to follow G. S. BRADY's example — as G. W. MÜLLER did in 1912 — and use the name given by A. PHILIPPI for this genus.

The genus *Copechaete*, E. HESSE, 1878 may be briefly dealt with here. This genus was identified by G. O. SARS, 1887, p. 13 with the genus *Asterope* PHILIPPI: „At den af HESSE under Benaevnelsen *Copechaete* opførte Slaegt er identisk med *Asterope*, er utvivlsomt".** G. S. BRADY and A. M. NORMAN, 1896, adopt this name as „undoubtedly" synonymous with *Asterope*, „but what his species are it is impossible to say". G. W. MÜLLER goes still farther; in 1912, pp. 45

* J. D. DANA himself writes, 1852, p. 1290, about the genus *Cypridina*: „It appears to include the *Asterope* of PHILIPPI."

** „It is clear that the genus established by HESSE under the name of *Copechaete* is identical with *Asterope*."

and 46 he succeeded in identifying the four species established by HESSE. — For several reasons I find it impossible to follow these authors. It is certainly true that the drawings with which E. HESSE illustrates his descriptions show in a number of respects, such as, for instance, the shell and furca, a certain, though only a superficial resemblance to the genus *Asterope*, but in most of the characters it is, however, quite impossible to find the slightest resemblance. Let us look, for instance, at pl. XII, fig. 6, which, according to the explanation, represents the anterior portion of the body. This figure agrees very well with E. HESSE's description, p. 18: „Antennes formées d'une seule paire, grêles, longues et multiarticulées, suivies de pattes thoraciques biramées, larges, plates, au nombre de cinq, garnies de fortes épines, de soies pennées ou de très-long crins divergents et ramifiés." The first antenna is long and very narrow, composed of nine joints of about equal length, each joint provided with from one to three short, fine, simple bristles. The second antenna is not, as in the genus *Asterope*, composed of a large muscular protopodite, a reduced endopodite and a long, slender exopodite with long natatory bristles along the ventral (anterior) margin, it consists, on the contrary, of two moderately long, subequal, broad, flattened branches of which the anterior one (the exopodite?) has a series of long natatory bristles along the posterior edge, a number of moderately long bristles along the anterior edge, the posterior one having a series of moderately long bristles along both the anterior and the posterior margins. The following limbs, two of which are drawn, are all of the same type; they are bifurcated, the anterior branch (the exopodite), with four or five joints, is relatively long, about twice as long as the posterior one, which has two or three joints; both branches are flattened and are furnished along both the anterior and the posterior edges with a series of powerful, moderately long or relatively short bristles. The latter limbs show a certain resemblance, though only a superficial one, to the posterior limbs of the free-swimming Copepods; they have, on the other hand, not the faintest resemblance with the peculiarly characteristic limbs of the genus *Asterope*. It may be unnecessary to draw any further comparison. If any importance at all is to be attached to the description and the figures the genus *Copechaete* must be considered as being not identical with the genus *Asterope*. E. HESSE himself puts his new genus as a representative of a new family by the side of „la famille des Bosminidiens" of the Cladocers. Whether this is correct I must leave for further discussion. It is certain that the genus *Copechaete* cannot be counted among the Ostracods. It seems most convenient, at least for the present, only to state that we do not know the natural position of this genus.

Mistakes committed by older authors in the description and explanation of the different organs. Progress of our knowledge of these organs.

Of the older writers who tried to give a description of forms belonging to this group, those whose descriptions are not merely confined to a general account of the shape and appearance of the shell commit very serious mistakes with regard both to the description and the explanation of the different organs. This is not surprising when one remembers the great difficulties these authors had to contend with.

Thus the incomplete description by which A. PHILIPPI introduced *A. elliptica* into the literature consists, as has been indicated above, almost exclusively of mistakes. The strong natatory antennae are interpreted by this author as the first (and only) pair of antennae of these forms, „Fühlhörner". Behind these there are „zwei Paar Füße . . . welche beide nach vorn gerichtet sind und nur zweigliedrig erscheinen . . . An der Basis der Füße sitzen zwei

beinah dreieckige, vorn ausgebogene und mit langen steifen Wimpern dicht besetzte Lamellen ob Kiemen? Hinter ihnen und vor dem Schwanz sah ich eine andre verschieden gestaltete und nur kurz gewimperte Lamelle. Außerdem fand ich drei Paar sichelförmige, lang gewimperte Palpen oder Kaufüße". The two pairs of feet seem to correspond to the first pair of antennae and the mandible; the organ that is assumed to be gills, is probably the maxilla, the then mentioned lamella is the sixth limb and the three pairs of palps finally mentioned seem to correspond to the comb and the epipodial plate of the fifth limb. The nature of the cleaning limbs has obviously not been understood by this author; these appendages are called „ein Paar cylindrischer, geringelter, mit einigen Borsten besetzter Fäden"; they are compared to the gills, four of which were observed, and it is assumed that, like these, they serve „zum Anheften der Eier". (This interpretation was presumably influenced by MILNE EDWARDS, who in 1840 called the seventh limb a „patte ovifère".) According to PHILIPPI the furca consists of only one lamella.

W. BAIRD, 1847, p. 23, interprets the first antenna correctly, he calls the second antenna a „natatory foot", the mandible is explained as the second pair of antennae, the maxilla as the „second pair of jaws", the fifth limb as the „first pair of jaws", the sixth limbs as „mandibles?" and the seventh limb, which in the description is included between „the natatory foot" and the maxilla, as the „oviferous foot". With regard to the scythe-shaped process on the first protopodite joint of the mandible, a figure of which is given, this author writes: „The part . . . . is unique, but I do not know its nature or use."

E. GRUBE's description of *Cypridina* (= *Asterope*) *oblonga*, 1859, shows in many respects an important advance in our knowledge of these forms. This author was the first to observe the rod-shaped organ in this family (as is shown on p. 164 this organ had, however, been observed in other *Cypridiniformes* by W. LILLJEBORG, 1853 and in *Halocypriformes* by J. D. DANA, 1852); GRUBE remained, however, ignorant as to the nature of this organ. This author gives drawings of the limbs which are, at least in parts, rather good. The first and second antennae and the mandible are given their right names, the endite on the first protopodite joint of the mandible is drawn attached to the base of this limb; it is called „hakenartige Fortsatz", without the author's attempting to give any indication of its nature. With regard to the explanation of the other limbs GRUBE is, however, less successful. He calls the maxilla „der sichelförmige zarte Wulst . . . am Rande der Mandibelpalpe". The fifth limb is placed some distance behind the sixth and is turned backwards; its epipodial appendage is called the first maxilla, its comb the second maxilla. The sixth limb is said to correspond to „der Lade der Mandibelpalpen" or else to belong to the „first maxilla". With regard to the seventh limb this author, like A. PHILIPPI, is so far behind MILNE EDWARDS, 1840, that he did not observe the nature of this organ as a limb; this appendage is called „griffelförmiger Anhang". Both the lamellae of the furca were observed. Curiously enough the gills, on the other hand, escaped attention. GRUBE writes about these as follows, p. 334: „Was die vier wurstförmigen hinter demselben" (= 7th limb) „am Rücken emporstehenden Körper bedeuten, die PHILIPPI an seiner *Asterope* abbildet, ist nicht näher angegeben, sind es vielleicht abgelöste und dort angebackene Eierklumpen?"

In G. S. BRADY's works 1868 a and 1868 b, on the other hand, some, though only minor, advances are noticeable. The descriptions and reproductions of the limbs certainly leave much to be desired, but the author is somewhat more fortunate than his predecessors in interpreting them. The first and second antennae, the mandible and the maxilla are explained correctly and the seventh limb is called the „oviferous foot"; the fifth and sixth limbs, of which a particularly misleading figure is added (1868 b, pl. 41, figs. f, g), are, however, incorrectly explained; their relative positions have been inverted and they are called the third and the second maxilla respectively.

After all these mistakes, due, of course, to the smallness of the object and the curious type and very concentrated position of the limbs, G. O. SARS, 1869, pp. 358—359, gives in the diagnosis of *Asterope norvegica* the first correct explanation of all the limbs; the description of these organs is, however, rather incomplete, nor is it illustrated by any figures.

FRITZ MÜLLER's essay „B e m e r k u n g e n ü b e r *Cypridina*" also denotes an advance in some respects. The rod-shaped organ is discussed, its capacity as a sensory organ is verified (cf. p. 164 above); the number and the nature of the gills is established (the occurrence of gills in forms belonging to this group was mentioned cursorily by this author as early as 1864, p. 73); contributions are made to our knowledge about the heart and the circulation of the blood (the occurrence of the heart in these forms was observed cursorily by this author as early as 1864, p. 72; cf. p. 164 above). With regard to the middle limbs, however, F. MÜLLER gives no information at all „um die Zahl der nur muthmaßlichen Deutungen nicht um noch eine zu vermehren".

Our knowledge of this family has subsequently been very considerably increased, especially by C. CLAUS's work of 1876, G. O. SARS's, 1887 and G. W. MÜLLER's, 1894.

The classification of this family. The division into natural groups.

As early as 1865 G. O. SARS points out (p. 101) that the species described by W. BAIRD under the name of *Cypridina Adamsi* seems to form „en distinct Slaegtstyp", — a distinct genus type — closely related to the genus *Asterope*.

In his large monograph of 1894 G. W. MÜLLER states (p. 218) that the then known forms of the genus *Asterope* s. l. may be divided into natural groups; an attempt at such a division was also made, but the groups that were set up received no special names. In the first group there were placed *Lobiancoi*, G. W. MÜLLER, 1894, *brevis*, G. W. MÜLLER, 1890 and *americana*, G. W. MÜLLER, 1890; they were characterized by their short, rounded shells, the uniting of the fifth and sixth joints of the first antenna and by their short, strong main claws, always few in number (three or four) on the furca. *Agassizi* (FR. MÜLLER, 1870) and *fusca*, G. W. MÜLLER, 1890 were to form one group; these two forms were characterized by lists running in the same direction on the surface of the shell, by the uniting of the sixth, seventh and eighth joints of the first antenna, by the small number of sensorial filaments on the sensory bristle of the fifth joint on this limb in the female and by the fact that the furca has only three slender and rather long main claws. Of the other species *oblonga* (E. GRUBE, 1859), *elliptica*, A. PHILIPPI, 1840 and *teres* (A. M. NORMAN, 1861) would be closely related to each other; they were characterized by the fact that the fifth, sixth and seventh joints on the first antenna are free and by having six main claws on the furca. G. W. MÜLLER assumed that *norvegica*,

G. O. SARS, 1869, *rotundula* (FR. MÜLLER, 1870), *cylindrica* and *australis*, G. S. BRADY, 1890 probably belonged to this group, but, on account of the unsatisfactory descriptions of these forms, he could not give a definite opinion as to this. *Hilgendorfi*, G. W. MÜLLER, 1890 would to a certain extent occupy a special position. „*Hilgendorfi* erinnert durch die Gliederung der 1. Antenne und die Gestalt der Furca an die Gruppe *oblonga*, von der freilich die Furca schon recht wesentlich abweicht, durch die allerdings nur spärliche Bedornung der Schwimmborsten, die starke Vermehrung der Borsten, besonders durch die Borsten am Dorsalrand der 1. Maxille, sowie durch die Gestalt des Putzfußes an die Gruppe *Lobiancoi*."

In his work of 1897 G. S. BRADY sets up a new genus, *Cyclasterope*, closely related to *Asterope*, and diagnosed it as follows (p. 85): „The shell is more nearly spherical than is usual in *Asterope*. Frontal tentacle stout, 3- (or 2?) jointed. The first joint of the mandibular foot has a falcate masticatory process as in *Asterope*, but much more elaborately spinous; the second joint, instead of being produced backwards in an angular process, bears on its distal margin a large tongue-like appendage which extends as far as the extremity of the following joint. The last limb (vermiform foot) is very profusely armed with setae, many of the segments bearing two or three on each lateral margin. In other respects the anatomy is that of *Asterope*." This new genus was based on investigations of two new forms, *C. Hendersoni* and *C. orbicularis*. It is not directly stated which of these two species is to be regarded as typical for this genus; one can, however, read between the lines that the species that is first described in the treatise, *C. Hendersoni*, is looked upon as the type-species by G. S. BRADY. This assumption is fully confirmed in G. S. BRADY's work of 1902 a. Here we read (p. 181): „This genus was founded on a species taken in Madras Harbour." *C. Hendersoni* is given (1897, p. 87) as having been „dredged . . . in Madras Harbour"; *C. orbicularis* is stated to have come from Valparaiso. — In the work of 1902 a just quoted G. S. BRADY describes three new species of the genus *Cyclasterope*. At the same time he feels compelled to modify the diagnosis of the genus given in 1897. On p. 181 we read: „The shape of the shell can no longer be maintained as a generic character, several other species having been discovered, which with a very different form of shell combine the other distinctive characters of *Cyclasterope*. The points which I now suggest as diagnostic of the genus are the presence of a digitiform process on the penultimate joint of the mandibular foot, the profusely setiferous character of the vermiform limb, each ring of which toward the distal extremity usually supports two or three setae, and the spinous armature of the joints of the swimming-branch of the antenna."

In his work of 1906 b G. W. MÜLLER adopts the generic name *Cyclasterope*. At the same time he points out, however, that a differentiation of this genus cannot be carried out on the basis of the diagnosis given by G. S. BRADY, partly because the characters given by that author are too indefinite, partly because one of them is due to incorrect observations (the mandible). G. W. MÜLLER then adds, p. 32: „Trotzdem scheint eine Abgrenzung der sehr kurzen, annähernd kreisförmigen Arten, welche bei BRADY die Gattung *Cyclasterope* bilden, nicht unberechtigt. Dieselben charakterisiren sich scharf durch den Bau der Furca, bei der auf 3 oder 4 kurze, kräftige, stark gebogene Dornen, welche in größerem Abstand von einander stehen, noch eine größere Anzahl dicht stehender borstenartiger Gebilde, welche sich in ihrer Form scharf von

den Dornen trennen, folgen." In other words G. W. MÜLLER uses BRADY's name *Cyclasterope* for the first of the three natural groups into which he had divided the genus *Asterope* in his work of 1894. In addition to these three species which were referred to this group in 1894 this author makes the genus *Cyclasterope* include four more species, *Cyclasterope orbicularis*, G. S. BRADY, 1897, *C. oculum* and *tenera*, G. S. BRADY, 1898 and *Cypridina zealandica*, W. BAIRD, 1850 b. On the other hand *Cyclasterope Hendersoni*, the species given by G. S. BRADY as the type-species, is not included in this genus. This species is synonymized with *Asterope Hilgendorfi*, G. W. MÜLLER, 1890 and is included, like *Cyclasterope fascigera*, G. S. BRADY, 1902 a, in the genus *Asterope*, „sie passen zu dieser Gattung (*Cyclasterope*) weder nach der Schalenform, noch nach dem Bau der Furca". According to G. W. MÜLLER's view, the genus *Asterope* includes, besides the two last-mentioned species, almost all the remaining species in this group. This genus was characterized by the fact that the furca is armed with at least five almost similar, slender claws, the distance between which is relatively small, „Zwischenraum kleiner als die Dornen an der Basis breit". This author then points out that with a classification of this sort there is no room for *Asterope fusca*, G. W. MÜLLER, 1890. He writes, p. 33: „Keinen Platz würde bei dieser Trennung finden *Cylindroleberis fusca*. In der Differenzirung der Furcaldornen würde sie sich *Cyclasterope*, im Bau der Dornen *Cylindroleberis* s. str. anschließen. Nach dem Bau der Schale nimmt sie unzweifelhaft eine ganz gesonderte Stellung in der Unterfamilie der *Cylindroleberinae* ein; bei einer Revision derselben müßte für diese Art eine besondere Gattung aufgestellt werden."

G. W. MÜLLER takes practically exactly the same view in arranging these forms in „Das Tierreich", 1912; the only exception is that *Cyclasterope tenera* is transferred to the heading „Cypridinidarum genera dubia et species dubiae". *Asterope fusca* is referred to the genus *Cyclasterope*.

The position of the Asteropids in relation to the other Cypridinids.

G. O. SARS, 1869, p. 359 is the first to show that the genus *Asterope* is very decidedly different from other Cypridinids and that a higher systematic unit ought to be formed from this genus, but this author does not set up any such unit. — We find a similar statement in G. S. BRADY, 1871, p. 292, but this author does not establish a systematic unit of this sort either. C. CLAUS writes in 1876, p. 94, note 1: „Ich würde die hervorgehobenen, namentlich auf die Mandibeln, die beiden Maxillenpaare und den Besitz von Kiemen bezüglichen Eigenthümlichkeiten für vollkommen ausreichend erachten, um *Asterope* den *Cypridina* ähnlichen Gattungen gegenüber als Familie der Asteropiden zu sondern. Jene Gattungen, *Cypridina*, *Monopia*, *Philomedes*, *Bradycinetus* stehen einander viel näher und würden als Cypridiniden vereinigt werden können." — C. CLAUS is accordingly to be regarded as the author of this systematic unit. G. S. BRADY and A. M. NORMAN say, however, that they are its authors, 1896, p. 628. — G. W. MÜLLER, 1906 b and 1912, gives the Asteropids as a sub-family; this author divides, as we know, the sub-order *Myodocopa* directly into families: *Cypridinidae*, *Halocypridae* and *Polycopidae*.

[illegible]

Remarks: — The systematic division of this group carried out by previous authors, even that which is given by G. W. MÜLLER in „Das Tierreich", 1912, must be considered rather

unsatisfactory from several points of view. The chief cause of this is probably that these authors have paid attention to too few characters.

A new classification of this family seems to me absolutely necessary and should be carried out as soon as possible. It may perhaps seem premature to attempt to do this at this early stage, as our knowledge of the species belonging to this group that have previously been described is very incomplete in most cases on account of the incompleteness and obvious uncertainty of these descriptions. In spite of this I thought it best to make the attempt.

The result of my work on this problem, which, merely because of the reason given above, can only be considered as a provisional one, is as follows:

Genus *Asterope* —

For description see below.

The number of species included in this genus has been considerably restricted. In addition to the species described by me below the following forms probably belong to this genus:

Asterope australis, G. S. BRADY, 1890, p. 515, pl. IV, figs. 1, 2.
Cypris bimaculata, H. NICOLET, in C. GAY, 1849, p. 294*.
Asterope cylindrica, G. S. BRADY, 1890, p. 515, pl. IV, figs. 7, 8.
,, *elliptica*, A. PHILIPPI, 1840, p. 188, pl. III, figs. 9—11.
,, *glacialis*, G. W. MÜLLER, 1908, p. 93, pl. VIII, figs. 11—15, pl. IX, figs. 17, 18.
,, *gracilis*, G. SEGUENZA, 1885, vol. 5, p. 58, v. 4, pl. II, fig. 9.
,, *grisea*, G. S. BRADY, 1898, p. 432, pl. XLIII, figs. 9—14.
Cylindroleberis inermis, G. W. MÜLLER, 1906 b, p. 34, pl. V, figs. 6—13.
Cypridina Mariae, W. BAIRD, 1850 c, p. 257, pl. XVII, figs. 5—7.
Cylindroleberis Mariae, G. S. BRADY, 1868b, p. 465, pl. XXXIII, figs. 18, 22, pl. XLI, fig. 1.
Asterope Mariae, G. S. BRADY and A. M. NORMAN, 1896, p. 630, pl. L, figs. 1—6, pl. LI, figs. 11—22, pl. LII, figs. 10—15.
Cylindroleberis Mariae, J. A. CUSHMAN, 1906, p. 366, pl. XXIX, figs. 19—25.
,, ,, CH. JUDAY, 1907, p. 143, pl. XIX, figs. 7—11.
Cypridina nitidula, FR. MÜLLER, 1870, p. 255, pl. VIII, figs. 9—12.
,, *oblonga*, E. GRUBE, 1859, p. 322, pl. XII, figs. 2—5.
Asterope ,, C. CLAUS, 1876, p. 92.
,, ,, G. O. SARS, 1887, p. 31, pl. I, figs. 5—8, pl. II, figs. 1—2, pl. V, VI.
Cylindroleberis ,, R. W. SHARPE, 1909, p. 423, pl. LXII, figs. 1—4.
Cypridina olivacea, J. D. DANA, 1849, p. 51**.
Asterope ovalis, C. CLAUS, 1876, p. 93.
,, *pacifica*, L. GRANATA, 1915, p. 29, fig. 4.
,, *quadrata*, G. S. BRADY, 1898, p. 432, pl. XLV, figs. 17—21.
Cypridina teres, A. M. NORMAN, 1861, p. 280, pl. XIV, fig. 10.
Cylindroleberis teres, G. S. BRADY, 1868 b, p. 465, pl. XXXIII, figs. 6—9, pl. XLI, fig. 2.

* G. S. BRADY believes (1880, p. 152) that this form is a *Cypridina*. This is certainly incorrect.
** Referred to *Philomedes* by G. O. SARS 1865, p. 107, to *Asterope* by G. S. BRADY, 1880, p. 159.

Asterope teres, G. S. BRADY and A. M. NORMAN, 1896, p. 636, pl. L, figs. 7–10, pl. LII, figs. 20, 21.

Type species: *Asterope elliptica* A. PHILIPPI, cf. below.

D i v e r g e n c e s f r o m t h e g e n u s *Asterope*, G. W. MÜLLER, 1912:

The following species are included in this genus by this author, but are excluded by me:

Cypridina Adamsi, W. BAIRD, 1847.

Asterope Arthuri, T. STEBBING, 1900.

Cyclasterope fascigera, G. S. BRADY, 1902 a.

,, *Hendersoni*, G. S. BRADY, 1897.

Asterope Hilgendorfi, G. W. MÜLLER, 1890.

,, *lichenoides*, G. S. BRADY, 1902 a.

Species which, contrary to G. W. MÜLLER, I include in this genus:

Cypris bimaculata, H. NICOLET, 1849.

Cypridina nitidula, FR. MÜLLER, 1870.

The two last-mentioned species are put by G. W. MÜLLER under the heading: „Cypridinidarum genera dubia et species dubiae." In spite of the incompleteness of the original description, there can scarcely be any doubt that *Cypridina nitidula* really belongs to *Asterope* in the sense that this genus has been taken in the present work. (This form is placed together with the forms in this group by G. W. MÜLLER, 1894.) But *C. bimaculata* is doubtful. Everything indicates, however, that this species too belongs to this unit.

Genus *Cyclasterope:* —

For d e s c r i p t i o n see below.

For reasons that are best seen in the historical resumé given above pp. 438, 439 it seemed to me necessary to give this genus quite another scope than G. W. MÜLLER had given it in 1912.

Besides the species *C. fascigera*, re-described by me below, the following species are probably to be included in this genus:

Cyclasterope Hendersoni, G. S. BRADY, 1897, p. 86, pl. XV, figs. 1—12.

Asterope Hilgendorfi, G. W. MÜLLER, 1890, p. 241, pl. XXV, fig. 15, pl. XXVI, figs. 8, 20, pl. XXVII, figs. 4—6, 17.

Nor does it seem impossible to me that *Asterope Arthuri*, T. STEBBING, 1900, p. 660, pl. LXXII, A should be included in this genus, but the position of this species is somewhat uncertain. (It is described from a male larva.)

Type species: *Cyclasterope Hendersoni*, cf. p. 438 above.

It was necessary to set up two new genera. These have been given the names *Cycloleberis* and *Asteropteron*.

Genus *Cycloleberis:** —

D i a g n o s i s: — The s h e l l, seen from the side, is rounded and has no decided posterior corner and no decided sculpture.

S e c o n d a n t e n n a: Exopodite: The natatory bristles have a strong equipment of spines; the basal spines are very powerful. Endopodite: This has rather numerous bristles on the first joint.

* From *κύκλος* = cycle and *λεβηρίς* = shell.

M a n d i b l e: The exopodite is relatively large. The endite of the first protopodite joint has comparatively numerous and powerful ventral spines and bristles. The second protopodite joint and the second endopodite joint have a very abundant supply of bristles.

M a x i l l a: There are a moderate number of bristles dorso-proximally on the basale; the end joint has rather numerous bristles.

S i x t h l i m b: The anterior and posterior margins are concave, the anterior and the posterior ventral corners, seen from the side, are pointed.

S e v e n t h l i m b: This has very abundant cleaning bristles; there are often, especially distally, two or three of these on the same side of the same ring. There are only two end combs?

F u r c a: This has three or four very powerful main claws, behind which follows a series of (always rather numerous) bristle-like secondary claws.

This genus comprises on the whole the same forms as G. W. MÜLLER, 1912 included in the genus *Cyclasterope.* The following species are probably to be placed in it:

Asterope americana, G. W. MÜLLER, 1890, p. 240, pl. XXV, fig. 16, pl. XXVI, fig. 9, pl. XXVII, fig. 11.

„ *brevis* „ „ „ 1890, p. 239, pl. XXV, fig. 10, pl. XXVI, fig. 7, pl. XXVII, figs. 7—10, 15, 16.

Cylindroleberis Lobiancoi, G. W. MÜLLER, 1894, p. 220, pl. IV, figs. 40, 42, pl. V, figs. 2, 3, 26, 32, 34, 40.

Cyclasterope orbicularis, G. S. BRADY, 1897, p. 87, pl. XV, figs. 13—19.

„ *ovulum*, „ „ „ 1898, p. 432, pl. XLIII, figs. 24—30.

„ *tenera*, „ „ „ 1898, p. 433, pl. XLIV, figs. 27—29.

„ *zealandica**, „ „ „ 1898, p. 433, pl. XLIII, figs. 15—23.

Type species: *Cycloleberis Lobiancoi* (G. W. MÜLLER).

D i v e r g e n c e s f r o m t h e g e n u s *Cyclasterope*, G. W. MÜLLER, 1912:

Species included by this author in *Cyclasterope*, but not by me in the genus *Cycloleberis*:

Cypridina Agassizi, FR. MÜLLER, 1870.

Asterope fusca, G. W. MÜLLER, 1890.

Species included by me in *Cycloleberis* but not by G. W. MÜLLER in *Cyclasterope*:

Cyclasterope tenera, G. S. BRADY, 1898.

The last-mentioned species is placed by G. W. MÜLLER, 1912, under the heading „Cypridinidarum genera dubia et species dubiae". It is very incompletely described and the type specimen was presumably far from being mature. In spite of this I think one may put it together with the species on which I have based this genus, without running too great a risk of being mistaken. G. W. MÜLLER in his work of 1906 b also places *C. tenera* together with these forms.

Genus *Asteropteron***: —

D i a g n o s i s: — The s h e l l varies somewhat in form. It is characterized by a very decided sculpture, (always?) with strongly projecting, partly longitudinal, ridges.

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* I must leave the question quite undecided as to whether this form is synonymous with *Cypridina zealandica*, W. BAIRD, 1850 b, p. 102, as G. S. BRADY assumes.

** From *Asterope* and *πτερόν* = wing.

S e c o n d a n t e n n a: Exopodite: The natatory bristles have no spines and there are no basal spines. Endopodite: The two proximal joints in the female have no bristles.

M a n d i b l e: The endite of the first protopodite joint has a moderate number of comparatively weakly developed ventral spines and bristles. The second protopodite joint and the second endopodite joint have a moderate number of bristles.

M a x i l l a: This has few or no bristles dorso-proximally on the basale.

S i x t h l i m b: Seen from the side, this appendage has both an anterior and a posterior pointed corner.

S e v e n t h l i m b: This has a moderate number of cleaning bristles, in most cases only one on the same side of the same ring.

The f u r c a has three long, curved, rather slender main claws, behind which there are a number (always rather few?) of considerably shorter and weaker secondary claws.

This genus includes two of the species placed by G. W. MÜLLER, 1912, in the genus *Cyclasterope*, viz.:

Cypridina Agassizi, FR. MÜLLER, 1870, p. 255, pl. VIII, fig. 26, pl. IX.

Asterope fusca, G. W. MÜLLER, 1890, p. 242, pl. XXV, figs. 11—13, pl. XXVII, figs. 19 to 22, 25.

It is possible that *Cyclasterope Liguriae*, L. GRANATA, 1915, p. 30, fig. 5 is also to be included in this genus; the position of this form is, however, very uncertain on account of the deficiency of the description.

Type species: *Asteropteron fuscum* (G. W. MÜLLER).

Species incertae sedis.

A number of other species are described, of which it may certainly be said that they belong to this family, but whose position, apart from this, is unknown on account of the incompleteness of the descriptions. Among these there are:

Cypridina Adamsi, W. BAIRD, 1847, p. 22, pl. VII. This species is included, as is seen above, in the genus *Asterope* by G. W. MÜLLER, 1912; it does not seem to me impossible that it belongs to the genus *Cyclasterope*. G. W. MÜLLER writes: „Vielleicht identisch mit *A. Hilgendorfi*?"

Asterope lichenoides, G. S. BRADY, 1902 a, p. 180, pl. XXIII, figs. 22—24. This species was also included in the genus *Asterope* by G. W. MÜLLER. I have myself had an opportunity of investigating the type-specimen of this species.* Unfortunately there was only the shell of this specimen and the distal part of one cleaning limb, which I discovered inside the shell. These organs were not sufficient to enable me to classify the species with complete certainty. I can however say that it does not belong to the genus *Asterope* in the sense in which this genus is taken in the present work. It will presumably be necessary to set up a new genus for it. The shell, which it is, as a matter of fact, absolutely necessary to describe again, indicated a close relationship to *Cyclasterope*; the cleaning limb was of about the same type as that of *Cycloleberis*.

Besides these two species two forms placed by G. W. MÜLLER under the heading „Cypridinidarum genera dubia et species dubiae" also come into this category. These are:

Cyclasterope similis, G. S. BRADY, 1902 a, p. 183, pl. XXIII, figs. 25—29.

Asterope squamiger, T. SCOTT, 1894, p. 140, pl. XIV, figs. 56, 57, pl. XV, figs. 14, 22, 23, 26.

* In the Zoological Museum at Copenhagen.

The position of *Cypridina albomaculata*, W. BAIRD, 1860 a, p. 201, pl. LXXI, fig. 1 is more uncertain. This species was placed by G. W. MÜLLER, 1912, under the same heading as the two forms just mentioned. On account of the size and shape of the shell and the arrangement of the fixing spots of the shell muscles, it does not seem to me impossible that this species may also belong to this family, and that it is most closely related to the genus *Cyclasterope*.

It seems still too early to give an opinion as to the mutual relations of the four genera dealt with above. It can, however, be said with a fair degree of certainty that *Cyclasterope* and *Cycloleberis* are comparatively closely related to each other. The genus *Asterope*, on the other hand, occupies a comparatively isolated position. The same thing may also be said of the genus *Asteropteron*.

Oecology of reproduction: — As in the case of the sub-family *Cypridininae* extremely little, or perhaps it would be more correct to say nothing at all, is known of the phenomena connected with the oecology of reproduction in this family. I myself can unfortunately contribute very little to the solution of this problem.

All the facts seem decidedly to support the view that in this family as well breeding is not limited to a more or less short period but takes place during the whole year.

When working at the material of the genus *Asterope*, so rich both in individuals and in species, on which the present work is based, it was very striking to notice how exceedingly rare the males were among the mature specimens, in most species they were even quite missing. In investigating the last larval stages I observed, however, that the males and the females were about equal in numbers, in some cases the males were even decidedly in the majority (three to one); cf. *A. Grimaldi*, below. G. W. MÜLLER had precisely the same experience previously (1894). As an explanation of this phenomenon he assumes (p. 13) that the males could escape the net owing to their superior powers of movement. „Eine andere Erklärung scheint mir kaum zulässig" . . . .

I cannot say for certain whether this explanation is correct. One m a y, however, imagine another explanation, which seems even more probable. This is that we have in these forms an oecology of reproduction which agrees with that which has been observed in the genus *Philomedes*. In other words after the last larval moult males and females live for a shorter or longer period planktonically. During this planktonic life copulation probably takes place. After copulation both sexes return to the bottom, the males dying comparatively soon afterwards, the females returning to their burrowing or digging life. It is probable that the planktonic life is longer in the case of the males than in the case of the females.

The fact that on several occasions these forms were found in plankton strongly supports the assumption of a planktonic copulation. I have myself found a male (undescribed) in the plankton material collected by the Swedish South Polar Expedition. G. S. BRADY, in his work 1868 a, p. 128 mentions that both *A. Mariae* and *A. teres* were caught planktonically, „though never very abundantly". The same author adds: „It would seem, indeed, that these animals do not come to the surface except after sunset". The same author mentions, 1898, p. 431, that males of *A. australis* were caught „abundantly" in plankton in „Otago Harbour". But females seem also to have occurred in the find in question, as is indicated by the following

statement: „The Otago gathering consisted almost entirely of males, the lesser swimming-power of the females doubtless keeping most of them at or near the bottom". In his work of 1902 a G. S. BRADY mentions (p. 180) that *A. oculata* was caught in plankton „plentifully". „These gatherings consisted, with one or two exceptions, entirely of males." Finally G. W. MÜLLER, 1906 b, p. 36, mentions that *A. australis* and *inermis* were caught planktonically, in both cases only one male.

The assumption that the males die comparatively soon after copulation is supported first by the fact that they are so seldom found benthoically, secondly by the fact that, owing to the modification of the first antenna during the last larval moult, they are less fitted to return to the burrowing life which they, like the females, led during their larval stages. It is to be noted, however, that the parts of the mouth do not — as in *Philomedes* — undergo reduction during the last larval moult; on the contrary, they are quite as well developed as those of the mature female.

Genus Asterope A. PHILIPPI.

Asterope, autorum; for instance A. PHILIPPI, 1840; G. O. SARS, 1865, 1869, 1870, 1872, 1886, 1887; G. S. BRADY, 1871; C. CLAUS, 1876; G. W. MÜLLER, 1890 (part.), 1912 (part.). (Non *Asterope*, S. FISCHER, 1855.) *Cypridina* (part.), autorum; for instance: W. BAIRD, 1847, 1850 a and b; J. D. DANA, 1852; E. GRUBE, 1859; A. M. NORMAN, 1861; F. MÜLLER, 1870. *Cypris* (part.), GAY, 1849. *Bradycinetus* (part.), A. M. NORMAN, 1867. *Cylindroleberis*, autorum; for instance: G. S. BRADY, 1868 a and b; G. W. MÜLLER, 1893 (part.), 1894 (part.), 1906 b (part.), 1908; J. A. CUSHMAN, 1906; CH. JUDAY, 1907; R. W. SHARPE, 1909 (part.), TH. STEBBING, 1910.

Description: — Shell: —

Female: — Seen from the side it is of a somewhat varying type, sometimes more or less elongated, elliptical or cylindrical, with its greatest height at about the middle, sometimes more or less short, egg- or pear-shaped, with its greatest height somewhat behind the middle and the posterior part more or less strikingly larger than the anterior part. Rostrum: The anterior margin does not project like a corner, but is broadly and uniformly rounded; its ventral corner is almost rectangular and is only slightly rounded. The incisur points obliquely upwards, is deep and rather narrow. Seen from beneath the shell is in most cases narrow and egg-shaped with its posterior part somewhat larger than the anterior. It is always a little higher than it is broad. The contours are well rounded and have no sharply projecting corners. The surface of the shell is smooth, without any decided sculpture; only after very strong magnification can one notice — besides the pores — a dense and exceedingly fine punctulation (very small foveolae?); it is practically quite without hairs and bristles. The selvage* is very narrow, with a smooth margin except along the inner part of the lower lip of the incisur and inside the part where the posterior margin of the shell passes into the dorsal margin, where it is broken up into rather short and very fine hairs (cf. *A. aberrata*.

* G. O. SARS states, 1887, p. 15, that the selvage is quite absent in this genus.

figs. 3 and 4). List: Inside the ventral margin of the shell this is more or less narrow, either quite without bristles or only with a very few short ones. Inside the posterior margin of the shell it is developed as a comparatively broad, hyaline lamella of uniform breadth and is provided with a somewhat varying number of soft, hyaline, somewhat sword-shaped spines and with a greater or less number of more or less short, fine, stiff, simple, bare bristles. The hyaline spines are often so transparent that they cannot be seen with full certainty, but their number is easy to verify by means of the oval fixing areolae. It is also very difficult to establish their length, for when the shell is looked at from the inside through the microscope, they are in most cases directed towards the eye of the observer; the length that I have drawn in the accompanying figures may often consequently be not quite correct. The latter part of the list is called in this work, as will be seen below, „the spine-bearing list" and forms a rather good species character, as the number of hyaline spines and bristles is often rather different in different species, but varies only slightly within each species. On the inside of the shell, on the rostrum, inside the incisur and between the list and the margin of the shell there are a varying number of simple, smooth, stiff bristles varying somewhat in length, which, on account of their number, length and especially on account of their situation, provide good characters for the species. Between the spine-bearing list and the posterior margin of the shell there is in a number of species a smaller number of broad pores and close to these a greater or less number of fine ones; the former were, at least in a number of cases, provided with low, hyaline pegs (which are protrusible?), the fine ones do not seem to have either pegs or bristles. (The latter, the fine pores are called by G. W. MÜLLER, 1894, p. 219, „kleine Spitzchen", the inner medial bristles on the rostrum are, on the other hand, called pores by the same author, ibid.) The shell is rather strongly calcified. The forms are moderately large.

Male: — This differs from that of the female as a rule by its greater length, though sometimes the female may be somewhat longer (cf. *A. curta*) and by the fact that the posterior part of the shell is somewhat lower. The wreath of hair round the posterior part of the shell is sometimes rather sparse; it consists of very fine hairs.

First antenna: —

Female: — This is very powerful and rather short and has its joints very much flattened from the sides. It has six or seven joints, according to whether the third and fourth joints are free or are united to each other; but even when these two joints are obviously free, they seem to have only a rather slight power of moving mutually; traces of the original boundary between them can always be discerned. The first and second joints are subequal and are each about as long as the total length of all the other joints. The third and fourth joints differ very much in shape from the other joints, as they are more or less triangular; the posterior edge of the third joint and the anterior edge of the fourth joint are very much shortened. The shape and the relative length of these two joints afford rather good characters for the species. The two next distal joints are always well developed and rather large; the end joint is small. All the species investigated by me appeared to have almost the same equipment of bristles. The second joint has on the anterior edge near the distal boundary a single rather powerful bristle, usually pointing forward and bent somewhat upwards, about as long as or rather slightly longer

or shorter than the anterior edge of this joint. Ventrally this bristle always has at the middle numerous long, stiff secondary bristles, some of which are arranged in pairs; distally it has short, fine hairs. In addition this joint has disto-laterally a bristle that is usually short and weak, with short, fine hairs. The third joint has along its anterior edge a series of five or six bristles (cf. also *A. abyssicola*, p. 536 of this treatise), of which the proximal one and the distal one are in most cases of about the same length as the bristle on the anterior edge of the second joint, the others being somewhat shorter. (On account of this only the approximate length of the anterior bristle on the second joint is given in the following descriptions of species.) All these bristles are rather powerful and point more or less forwards and are bent more or less upwards. The proximal one (= bristle no. 1) has about the same equipment as the anterior bristle on the second joint; most, sometimes all, of the remaining bristles are furnished at the middle with a greater or less number of more or less long and stiff ventral secondary bristles and have short, fine hairs distally; the one or more that remain have short hairs but no long secondary bristles. The equipment of these bristles was, in the species investigated by me, fairly constant within the species. On the short posterior edge of this joint there is only one exceedingly short and weak bristle. On the short anterior edge of the fourth joint there is also only one bristle, which is of about the same length and strength as the distal bristles on the anterior edge of the third joint and always has short, fine hairs distally. Postero-distally on the same joint there issue two rather weak bristles with fine, short hairs. These bristles are of moderate and rather different lengths; the length of these bristles was observed to be rather different in a number of species, but within each species it was subject to very slight variations. The fifth joint has only one bristle, „the sensory bristle of the fifth joint". In all the species of this genus that were investigated by me this bristle consisted of a rather powerful, densely annulated trunk, of about uniform thickness, differing somewhat in length in different species and having disto-anteriorly six subequal and rather thick sensorial filaments placed closely together, of about the same length as or somewhat longer than the trunk of the bristle. In a number of species there is an additional sensorial filament on this bristle (thus making seven altogether) at about the middle of the anterior side of the trunk; this sensorial filament is considerably narrower than the six former ones and is in most cases not quite half the length of the trunk of the bristle. All these sensorial filaments are of about a uniform thickness and are distally rounded, almost completely hyaline, bare and provided with a short, fine sensory hair at the point. — It is to be noted that J. A. CUSHMAN, 1906, pl. 29, fig. 22 draws this bristle as simple without any lateral filaments, although sensorial filaments are drawn on the bristles of the end joint in the same figure.* — The bristle on the sixth joint was of the same type in all the species of this genus that were investigated by me, being in most cases somewhat longer than the total length of the three distal joints, rather powerful and furnished with short hairs. The small end joint, which is in most cases rather strongly chitinized, has six or seven bristles. The a-bristle, situated anteriorly, was, in all the species

* C. CLAUS states, 1876, p. 93, that in *A.* [illegible] this bristle has five sensorial filaments, but he draws six; evidently this writer counts one filament as the „trunk" of a bristle, a method which is perhaps the right one from a theoretical point of view, but which has been rejected in this work for practical reasons; it is almost impossible to decide which of these filaments is the distal part of the bristle, all of them being perfectly similar.

of this genus that I investigated, developed as a very powerful moderately long, strongly chitinized digging claw, bent slightly upwards and directed somewhat forward, only slightly annulated; it is denoted as the „a-claw" in the following descriptions of species. All the other bristles on this joint are developed as sensory bristles.* The b-bristle is situated behind and somewhat medially of the a-claw. It is of quite the same type in all the species investigated by me, about as long as or rather slightly longer or shorter than the total length of the third to the seventh joints; its proximal half is rather powerful and grows gradually narrower distally and is closely annulated; its distal half is differentiated as a rather thin sensorial filament of about uniform thickness and more or less completely hyaline; at about the middle of its anterior side there issue, fairly close to each other, three subequal sensorial filaments, which are about half as long as the bristle, and somewhat proximally of these there is a considerably shorter filament, which is also situated on the anterior side of the bristle; the distal part of this bristle, like its filaments, is partly furnished with extremely fine and short hairs. The c- and g-bristles: The c-bristle is situated posteriorly and proximally on the joint, the g-bristle is somewhat in front of and distally of the former. These are of the same type, subequal, about as long as the anterior side of the second to the fourth or sometimes even the second to the sixth joints; they are rather powerful proximally, closely annulated; they grow gradually narrower distally, the annulation disappearing at the same time, and become a rather thin and more or less completely hyaline sensorial filament; on the anterior side they have more or less uniformly distributed, moderately long and rather thin sensorial filaments in moderate and somewhat varying number (from five to nine were observed); these filaments are bare. The f-bristle is fixed laterally on the joint. It is somewhat shorter than the c- and g-bristles and is of the same type as these. Its sensorial filaments issue, however, on its posterior edge; this has probably some connection with the fact that this bristle is always directed forward at about a right angle or even somewhat upwards, while the b-, c- and g-bristles are only pointed very weakly forward. (Often, however, somewhat more than is shown in the accompanying figures; for practical reasons one or more bristles have been drawn in these figures pointing somewhat more ventrally than they actually did in the corresponding preparations.) The number of sensorial filaments observed on this bristle was four or five; the distal part of the bristle, like the filaments on the posterior side, are often partly furnished with very fine, short hairs. The sensorial filaments on both b-, c-, f- and g-bristles are of about equal thickness, more or less completely hyaline and, like the main bristle, distally rounded and furnished at the point with a short, very fine hair. D- and e-bristles are situated laterally, somewhat behind the f-bristle; they are simple, rather narrow and almost equally thick sensorial filaments, rounded distally, closely and finely annulated, sometimes almost hyaline distally. The e-bristle, often about as long as the total length of the third to the seventh joints, is always well developed. The d-bristle is well developed in a number of species, but is always somewhat weaker and shorter than the e-bristle; in most species, however, it is reduced; even in these cases, however, I was always able to observe it on the species investigated by

* G. W. MÜLLER (1894) denotes the d-bristle (like the sensory bristle of the fifth joint) by s. b., sensory bristle, which is, of course, not right, because, as has been pointed out above, all the bristles of the end joint, except the a-claw, are to be looked upon as sensory bristles (Cf. G. W. MÜLLER, 1894, pls. 2, 3 and 4).

me as a small verruciform process situated anteriorly of the e-bristle. Pilosity: The first and second joints are often furnished with more or less abundant groups of fine, short, stiff hairs, often arranged in transverse rows on the second joint.

M a l e: — This is not quite so powerfully built as that of the female and is somewhat longer and more slender in comparison. Its joints are not so much flattened at the sides. It has six or seven joints; the third and fourth joints are always free. The fifth joint is well defined from the fourth; on its proximal edge there are the distal fastenings for no less than three rather powerful muscles. The boundary between this joint and the sixth joint is, on the other hand, sometimes not so well developed; sometimes, perhaps, these joints are quite united; the sixth joint is not moved by any specific muscles. The relative proportion of the joints is subject to some variation within the genus. The following figures may be given as examples (the measurements are from *A. norvegica*, with a shell 2,42 mm. long):

$$\mathrm{I}\ \tfrac{33}{27};\ \mathrm{II}\ \tfrac{43}{28};\ \mathrm{III}\ \tfrac{18}{7};\ \mathrm{IV}\ \tfrac{5}{9};\ \mathrm{V}\ \tfrac{7}{2};\ \mathrm{VI}\ \tfrac{12}{8};\ \mathrm{VII}\ \tfrac{6}{14}.$$

For the sake of comparison the corresponding figures for the female are also given here. (The same species as above, with a shell 2,2 mm. long. The scale is the same as above.)

$$\mathrm{I}\ \tfrac{27}{23};\ \mathrm{II}\ \tfrac{31}{16};\ \mathrm{III}\ \tfrac{15}{2};\ \mathrm{IV}\ \tfrac{1}{11};\ \mathrm{V}\ \tfrac{11}{7};\ \mathrm{VI}\ \tfrac{4}{7};\ \mathrm{VII}\ \tfrac{2}{5}.$$

The proportion between the joints in this antenna of the male and the female consequently differs fairly considerably (cf. also *A. curta*, p. 501 of this treatise). The fifth joint is rather considerably shortened, its posterior edge is so short that the sensory bristle often seems to be attached close to the two posterior distal bristles of the fourth joint. The seventh joint is very considerably larger than in the female, its posterior edge especially is very considerably lengthened. The boundary between the sixth and the seventh joints is of so irregular a type that mistakes can easily be made. Observation is often rendered difficult, in addition, by the fact that sometimes it is not very distinctly developed and that accessory chitinous creases arise. I need only refer here to fig. 11 of *A. Grimaldi* and fig. 7 of *A. curta*; in the former the contour of the boundary of one side is drawn with an unbroken line, and that of the other side with a dotted line. I have been and am almost still in doubt as to whether that part of the end joint on which the (d-), e-, f- and g-bristles are fixed, is really to be considered as a special joint or not. The idea that this part is a special joint is supported especially by the fact that it can move freely by means of two powerful muscles. The fact that I do not accept this interpretation but consider this part as a portion of the seventh joint is due entirely to its exceedingly small size; the muscles seem, as a matter of fact, to be fixed directly to the basal part of the bristles.* The number and position of the bristles is the same as in the female; with regard to their development, however, there is a not inconsiderable difference between the two sexes. The lateral bristle on the second joint is somewhat longer than in the female. The anterior bristle on this joint is somewhat weaker. The bristles on the anterior edge of the third joint are also somewhat weaker than in the female and are somewhat shortened; some of them are even very much shortened. The sensory bristle of the fifth joint: In what seems to be the

* This part is, however, as we know, developed as a distinct joint in most of the representatives of the subfamily *Cypridininae*.

majority of species the trunk is considerably stronger and also somewhat longer than in the female and is furnished with very numerous sensorial filaments along almost its whole length; the six distal ones of these filaments are practically quite like the six distal sensorial filaments on this bristle in the female, with which they are also probably homologous; the other sensorial filaments, the accessory ones, are about as long as but somewhat narrower than those just mentioned; they are situated on one side — on the anterior-medial side — of the bristle along the proximal part of the stem of the bristle, and are arranged more on all sides distally; they are also, at least partly, arranged in a number of transversal rows (in the cases investigated about thirteen to twenty rows were observed). In a number of forms (cf. *A. curta* p. 501 of this treatise) this bristle shows quite the same type as in the female. G. W. MÜLLER describes (1908, p. 93) a species *A. ovalis* (= *A. glacialis*, G. W. MÜLLER, 1912), which, as is shown on p. 503 of this treatise, is very closely related to *A. curta*; the male of this species appears to be characterized by having this bristle rather weakly developed and provided with only a few sensorial filaments, according to the text „etwa vier", according to the accompanying figure five (pl. 8, fig. 15).* The a-claw is rather considerably weakened, but is distinctly claw-like. The b-bristle is only rather slightly lengthened; its sensorial filaments, which are only slightly or else not at all increased in number (in all the cases investigated the number was increased by only a single filament), are somewhat more uniformly distributed along the proximal half of the bristle. The c- and f-bristles are of the same type as in the female, but are enormously lengthened, being about $1^{1}/_{3}$ times or $1^{1}/_{2}$ times as long as the shell, and have a considerably greater number of sensorial filaments. The g-bristle is only slightly longer and the number of its sensorial filaments is rather slightly greater than in the female. The f-bristle is not, as in the female, directed rectangularly forward, but in the longitudinal direction of the antenna, the b-, c-, and g-bristles are also pointed somewhat less forward than in the female. On the end joint there is latero-posteriorly a powerful chitinous verruca, which is quite absent in the female (cf. fig. 8 of *A. norvegica*). From it the e-bristle issues basally-anteriorly; this bristle is of the same type as in the female; it always seems to penetrate between the c- and g-bristles and is held medially of these bristles (cf. fig. 8 of *A. norvegica*, fig. 11 of *A. Grimaldi* and fig. 7 of *A. curta*). I could not observe any trace of the d-bristle. Whether this latter bristle is developed in the males of such forms as have it developed in the females, I cannot decide, as no such forms were present in my collection. The pilosity is weaker than in the females.

Second antenna: —

Female: — The protopodite has a very short bristle distally-medially close to the exopodite; this bristle was observed in all the species dealt with in this treatise except *A. Grimaldi* and its variety. The exopodite is about as long as the protopodite; the proportions between its joints are as follows:

I : II : III : IV : V : VI : VII : VIII : IX = 30 : 6 : 3 : 3 : 3 : 3 : 3 : 3 : 2,

i. e. the first joint is about as long as or somewhat longer than all the following joints together, the second joint is about as long as the total length of the two following joints. The first joint

* G. W. MÜLLER evidently counted one of the filaments as the distal part of the bristle.

has no bristles. The bristle of the second joint is powerful and is about the total length of the seven distal joints; ventrally it is furnished with short, stiff secondary bristles but has no spines; only in exceptional cases (cf. *A. aberrata*) are these secondary bristles relatively long; distally it has a fine point. The bristles on the third to the eighth joints are long, powerful natatory bristles, some of which are sometimes almost double the length of the exopodite. These bristles have rather long but comparatively narrow natatory hairs and are furnished with short spines along a large part of the ventral side; these spines are as a rule rather strong on the proximal natatory bristles, very weak on the distal ones; in a number of species I have even been quite unable to observe them on the most distal of these bristles (with REICHERT's oc. 4, LEITZ' imm. $^1/_{12}$) (quite missing?). The end joint has three or four bristles, two of which are developed as long natatory bristles. On these two, which always seem to be somewhat shorter than the other natatory bristles, I have succeeded in observing, at least in some cases, weak ventral spines; in most cases, however, there seem to be no spines at all on these bristles. These two bristles, like the other natatory bristles, are furnished distally with a short, fine hair, but apart from this they are not differentiated as specific sensory organs. The two remaining, dorsal, bristles of the end joint have short hairs but have no spines; one of them is often about as long as the total length of the four or five distal joints, the other is somewhat shorter; one of them may sometimes be quite absent. The fourth to the ninth joints — less frequently the third to the ninth — are each often furnished with a basal spine. These spines are often broadly conical; the one on the ninth joint is the largest, being sometimes about as long as this joint, the others decrease more or less uniformly in size and strength the more proximally they are attached, the proximal one being in most cases rather weak, somtimes even scarcely perceptible. In a number of species, however, the number of basal spines is reduced, sometimes they are even quite absent. Distally-dorsally on the second to the eighth joints there is a series of hairs, in most cases very short and rather coarse, or of weak spines; on one or more joints, differing in different species, they are sometimes not inconsiderably longer than on the other joints. On the first joint there were observed in most of the species described in this work one or two transverse rows of fine, rather short hairs dorsally near the distal boundary. The endopodite is more or less clearly three-jointed and has only one bristle, the distal bristle of the end joint; this bristle is closely and finely annulated, of about uniform thickness and is rounded distally. Sometimes a short bristle was observed distally on the second joint; this was obviously abnormal.

Male: — Both the protopodite and the exopodite are considerably more strongly developed than in the female. Exopodite: The proportions between the joints are somewhat different from those of the female (cf. the descriptions of the species). The bristle of the second joint is considerably lengthened, but it is not quite so long as the natatory bristles on the nearest joints. The end joint has three long natatory bristles, as one of the short bristles of the female is rather considerably lengthened — but not quite so long as the natatory bristles of the nearest joints — and is provided with well-developed natatory hairs. In species with four bristles on the end joint the fourth bristle is also somewhat longer than in the female and is provided with well-developed natatory hairs. The natatory bristles on the third to the ninth joints are also somewhat longer than in the female. All the bristles are without any spines.

and the basal spines are very much reduced. Dorsally-distally on the second to the eighth joints there is a cluster of rather long, fine hairs. E n d o p o d i t e: The end joint is rather decidedly curved and is somewhat more than half the length of the second joint; it can be folded back against a corresponding furrow on the second joint. The first joint has no bristles at all. The second joint has (always?) three bristles ventrally at about two-thirds or three-quarters along the joint. The end joint has a single bristle proximally on the outside; this bristle is of about uniform thickness and is rounded distally.

M a n d i b l e:

F e m a l e: — This is relatively short, but is very powerfully built, with its joints decidedly flattened at the sides. The proportions between the joints are about the same in all the species investigated by me and are illustrated by the following figures (from measurements carried out on a specimen of *A. norvegica*, ♀):

I Pr. $\frac{4}{20}$; II Pr. $\frac{12}{20}$; I End. $\frac{11}{9}$; II End. $\frac{18}{12}$; III End. $\frac{1}{2}$.

P r o t o p o d i t e: Coxale: This has no bristles. The endite issues from, or perhaps it would be more correct to say forms basally, a chitinous list, which extends transversely across the joint; cf. G. O. SARS, 1887, pl. IV, fig. 4. The scythe-shaped process is uniformly and moderately strongly curved in two planes, partly upwards, partly inwards, and is, in addition, slightly twisted so that its medial side is turned somewhat upwards; it is thus turned towards the mouth, in which I often found it inserted (already observed by G. W. MÜLLER; cf. 1894, p. 46). On the distal part of its ventral edge there is always a more or less strongly developed spine, pointing proximally, characterized by the fact that it is continued by a low ridge, in most cases rather short, on the lateral side of the process. This ridge forms a curve which is concave proximally and is furnished, like the spine, with a close series of rather short, fine, stiff spines, pointing proximally. Proximally of this spine there is along the ventral edge of the process a number — in most cases rather small — of protuberances or spines; these are most frequently somewhat different in number and type in different species; within the species they are certainly not constant, but their variation is not so great that they cannot to some extent serve as a character for the species; I often found them rather strongly worn, which may, of course, modify their appearance considerably. From some of these spines a series of low protuberances runs in a dorso-proximal direction on the lateral side of the process; in a number of species these protuberances are rather numerous, in others they are more or less sparse; in addition they are also subject to some variation within the species. Distally of the middle the dorsal edge is often serrated along, in most cases, a rather short part; the teeth vary in size, in some species they are even almost completely reduced. The dorsal edge is, in addition, distinguished by a single bristle, in most cases rather long, which is situated almost opposite or somewhat distally of the above-mentioned proximally pointing spine on the ventral edge of the process. On a great part of the surface of the process there are numerous striations, generally speaking parallel to each other, of which the distal ones at least are furnished with close, extremely short and fine hairs pointing distally; these hairs are scarcely perceptible even with very strong magnification (REICHERT's oc. 4, LEITZ's immers. $\frac{1}{12}$). Similar striations, running across the process in distally concave

curves, are found both on the lateral and the medial sides of the process; they are, however, very much more numerous on the lateral side. The striatory systems of the two sides cross, because the striations on the medial side, which are also distinguished by having somewhat coarser hairs, form a more acute angle to the longitudinal axis of the process. I have observed, however, that the two systems join each other, at least on the dorsal edge of the process. The distal part of the process has no striations; this part is covered laterally by a mat — in most cases very thick — of short, very fine hairs. There are also often short, fine hairs on the bristle of the dorsal edge. In addition there are some transverse rows of rather short, fine hairs laterally-ventrally somewhat proximally of the middle of the process. Some irregular lists (strengthening lists according to G. W. MÜLLER, 1894, p. 46) run in the longitudinal direction of the process; these are in most cases not drawn at all in the figures given in this work of mine. The rod-shaped process is rather narrow, not quite half as long as the scythe-shaped process. Along the greater part of its length it is furnished with rather short, strong bristles; on both the medial and the lateral sides of the process most of these bristles are arranged in a rather small number (about three to six) of transverse rows; the ventral bristle in each row is in most cases the longest, the others decrease fairly uniformly in length dorsally. The rod-shaped process is blunt distally and is provided there with three or four short spines or bristles. Basale: The backward pointing process is well developed and is furnished with a rather small number of bristles (from six to eleven were observed on the species investigated by me). Of these bristles the three or four nearest to the point of the process are rather long and powerful and are characterized by having numerous short secondary spines, arranged in two rows and placed close together, along the greater part of their length; these spines are rather powerful proximally and become more and more fine distally (cf. fig. 9 of *A. spinifera*). From one to five, in most cases from three to five, of the other bristles are also most frequently rather long and powerful and are characterized by having a greater or less number of secondary spines, arranged in two rows and situated close together distally; the distal pair of these spines is the most powerful, extending no inconsiderable distance distally of the point of the bristle; the others are rather short. The remaining one or two bristles are short and weak, bare or provided with exceedingly fine, short hairs. In the neighbourhood of these bristles a rather large number of unicellular glands have their openings on a more or less developed verruciform process. Dorso-distally this joint always has two bristles with more or less short hairs; these bristles are, as a rule, considerably longer than the anterior side of the first endopodite joint. Apart from these the dorsal side of the second protopodite joint is quite without bristles in a number of species, in others it has a larger or smaller number of these, characteristic for the species. E x o p o d i t e: The two ventero-distal bristles of this branch are always very short. This branch is furnished dorsally with exceedingly numerous short, fine hairs (the exits of the glands). E n d o p o d i t e: The first joint has only three ventral bristles. Of these the two posterior ones especially are very long; they are in most cases somewhat longer than the anterior side of the endopodite and are always furnished at the middle with a number of rather long and powerful anterior secondary bristles, arranged in two rows; proximally of these secondary bristles there is in a number of species a varying number of short secondary bristles; these two bristles have short, fine hairs distally. The

remaining one of these three bristles is somewhat shorter than the former ones and has in most cases short, fine hairs; it is rarely provided at the middle with a number of long secondary bristles. Antero-distally this joint is in exceptional cases furnished with powerful chitinous spines (cf. *A. spinifera*, fig. 10). The second joint has postero-distally three rather long bristles with short, fine hairs; two of these bristles are situated close to each other somewhat distally of the third. The proportions between these bristles were subject to only slight variation in the species investigated by me: one of the two distal ones and the proximal one are either subequal or else the latter is somewhat longer; the remaining one of the two distal bristles is considerably shorter than the two former ones and is also often characterized by being somewhat curved dorsally. Along the anterior edge of this joint there are a rather large number of bristles. Among these may always be noticed four powerful and rather long ones, in most cases subequal, situated at about equal distances from each other along the whole of the joint and generally sparsely provided with short and fine hairs, sometimes apparently even quite bare. These four bristles are called the „main bristles" in this treatise and are denoted proximo-distally with the letters a—d. Proximally of and close to the proximal one of these bristles, the „main bristle a", there are from one to a small number, different in different species, of rather weak bristles with short, fine hairs or bare, often rather considerably shorter than the main bristles. Between the main bristles b and c there is in a number of species a rather weak bristle with short, fine hairs. This bristle is of rather considerable length, in most cases, however, not quite so long as the main bristles; in a number of species it is quite absent. Between the main bristles c and d there is in all the species investigated by me a similar rather weak bristle with short, fine hairs; this bristle is often about as long as the main bristles. An additional bristle of this sort, but somewhat shorter, was always observed distally of and just near the main bristle d. Finally there is anteriorly on the medial side of this joint a greater or smaller number of moderately long or rather short cleaning bristles, characterized by being furnished distally with close, rather short, in most cases rather powerful secondary bristles, arranged in the shape of a feather. These bristles are partly arranged in a few more or less distinct rows running slantingly upwards and forwards. On the species investigated by me I have always seen a row of this sort, running within the main bristle c. In these rows of bristles the anterior bristles are somewhat, sometimes even considerably, longer and more powerful than those situated farther back. The cleaning bristles vary somewhat within the species both with regard to number and position; they may, however, be used to some extent as a character of the species. The end joint has six bristles, of about the same type and position in all the species investigated by me. The anterior one is developed as a powerful claw. Three have about the same type and length as the main bristles of the second endopodite joint. Of the two remaining ones, both rather weak, with short hairs, one is situated close to the claw, the other between the two posterior of the three long and powerful bristles; the former of these two bristles is always somewhat longer, the latter always somewhat shorter than the claw. Pilosity: The second endopodite joint has numerous groups of short, fine, stiff hairs on the inner side.

Male: — As has been pointed out above, the male mandible agrees in all essentials with that of the female. It seems to be too early to try to generalize the dimorphism, because of the

comparatively small number of species of which both male and female are known. I refer the reader to the descriptions of the species and will only point out here that variations have been observed in the backward pointing process on the basale (in some species), the equipment of the shortest of the three ventral bristles on the first endopodite joint, the bristles proximally of the main bristle a of the second endopodite joint and the cleaning bristles of this joint.

Maxilla: — Protopodite: On the procoxale and coxale there are two very strongly, sometimes almost completely, reduced endites. Of these endites the proximal one was, in all the species investigated by me, provided with four bristles, three of which were subequal, rather long and powerful, the fourth, situated between the two proximal of the three former ones, was rather weak and not quite half as long as these. The distal endite is in most cases furnished with only three bristles, which are sometimes subequal and of about the same length and strength as the three long bristles of the proximal endite, while sometimes the middle one of them is somewhat shorter. In only one species, *A. oculata*, was there observed between the two distal of these three bristles a bristle of about the same kind as the short bristle on the proximal endite. The long bristles on these endites always have, at least in parts, rather long hairs, of which those that issue from the distal part of the bristles are arranged in the shape of a feather and are rather coarse. The one (or the two) short bristles are bare or have very fine and short hairs. The posterior bristles in the baleen are only about a third or a half the length of the anterior ones. The baleen bristles are widened out distally somewhat in the shape of a lancet and are pointed (not blunt as in pl. 5, fig. 15 a, G. W. MÜLLER, 1894; cf. p. 465 of this treatise of mine), somewhat boat-shaped (if I am not mistaken) and furnished at the edge with exceedingly fine hairs, scarcely perceptible even with very strong magnification (REICHERT's oc. 4, LEITZ's immers. $\frac{1}{12}$); cf. fig. 14 of *A. Grimaldi*. The posterior bristle in the baleen is of about the same type in all the species investigated by me; it is of moderate length, its distal part is somewhat lancet-like, inclined forwards and finely and closely pectinated along the ventral edge; cf. fig. 15 of *A. Grimaldi*. On the outside of the protopodite there is only a single bristle; it is moderately long, and situated on the basale, about half-way up the joint, beneath the epipodial appendage; it is of about the same type in all the species investigated by me. On the inside of the protopodite there are a number of bristles, which afford rather good characters for the species by their number and relative length. Dorsally, just in front of the fastening of the epipodial appendage, there is a single bristle; I was unable to decide with certainty whether this issues on the coxale or on the basale. Dorsally on the distal part of the basale there is in most of the species one or a small number of bristles. About half way along this joint there is ventrally one or a small number of bristles. A short distance distally of this (them) there is in most cases a very short bristle, situated ventrally on the joint between the baleen and a list-like medial part; this bristle is in most cases very difficult to observe with certainty on account of its small size and its concealed position. Finally the basale has a rather long bristle ventrally and somewhat laterally close to the boundary of the endopodite. This latter bristle is furnished with rather long and exceedingly fine hairs, the other bristles of the protopodite are bare or have extremely fine, short hairs. The epipodial appendage, issuing presumably distally on the coxale, is compressed at the sides

almost like a lamella and is about half the length of the basale (cf. p. 464 below); it grows rather decidedly narrower towards the point, is directed forwards and has its ventral edge pressed against the dorsal side of the protopodite. The endopodite has a constant number of bristles: The first joint has a short, often bare, bristle on the anterior side, situated in most cases somewhat distally of the middle of the joint. This joint has in addition postero-distally a long bristle with short, fine hairs. The end joint has only one bristle, long and with short, fine hairs. The inside of the protopodite and the epipodial appendage are abundantly furnished with short, fine hairs, arranged in groups or irregular rows.

Fifth limb: — In all the species of this genus investigated by me this limb has practically the same structure; it has not been used, as we shall see below, as a characteristic for the species. — The comb is relatively narrow, with a uniformly curved dorsal edge. The comb bristles are rather numerous; those situated nearest to the anterior point of the comb are somewhat longer than the others; they are all pointed and finely annulated and are equipped with abundant short, fine hairs. Most of the comb bristles are situated right on the ventral margin of the comb, a few are displaced somewhat dorsally; thus from three to five of these bristles were always observed displaced somewhat dorsally up on the lateral side of the comb near the long bristle of the distal exopodite joints. The distal joints of the exopodite are represented by a long, powerful bristle pointing forwards, extending in all the species investigated by me a short distance beyond the anterior end of the comb and thickly furnished with long, fine hairs arranged in the shape of a feather; cf. p. 465 below. Somewhat ventrally of this bristle there are always two short, subequal bristles, pointed similarly forward; only in one of the species investigated by me, *A. norvegica*, was only one of these bristles observed. Dorsally of the distal comb bristles there is a series of rather long and coarse hairs; apart from these the comb is to a great extent bare; at some places, however, short, fine hairs may be observed. The epipodial appendage is somewhat ear-shaped and is characterized by the fact that the bristles somewhat ventrally of the middle decrease very markedly in length and then again increase strongly in length on the ventral lobe; a greater or smaller portion of the distal part of these bristles is often bare or furnished with short hairs, but, as far as one can see, is not modified as a sensory organ. See fig. 14 of *A. aberrata*.

Sixth limb: — Seen from the side it is lamelliform. The posterior margin is straight or very slightly concave or convex and is marked off from the ventral margin by an always well-rounded corner. The ventral margin is slightly and in most cases fairly uniformly convex. The anterior margin is more or less decidedly concave, with a pointed corner marked off from the ventral margin. Seen from beneath it is rather decidedly flattened anteriorly, somewhat sole-shaped, with a well-rounded anterior edge; posteriorly it is narrow and lamelliform; cf. fig. 16 of *A. Grimaldii*. On the anterior edge there are usually two bristles with short hairs or bare (= remains of endites on the protopodite and the exopodite?); one of these is usually attached at or somewhat above, the other somewhat beneath a point half way up the limb; sometimes there is only one, the upper one, of these bristles, sometimes the ventral one is duplicated; cf. also the description of this limb in *A. abyssicola*. Along the anterior edge of the sole-shaped flattened part of the ventral side there is a small number of rather short bristles,

the number differing in different species. Separated from these bristles by a marked gap there is along the posterior part of the ventral margin a smaller or larger number of bristles, the anterior ones of which are usually rather short, the posterior ones moderately long. All these ventral bristles have rather long and often rather fine hairs along a smaller or greater part of their length and have short hairs distally; the posterior ones, however, often have long hairs right to their points. Some of the bristles along the anterior edge of the anterior sole-shaped flattened part of the ventral side always seem to be developed, the other ventral bristles may be quite absent; cf. *A. aberrata*. This limb is covered to a great extent with abundant short, fine hairs, many of which are arranged in groups.

Seventh limb: —

Female: — This is moderately long; in one female specimen of *A. norvegica* the shell of which was 2.1 mm. long it was 1.2 mm. The distal part of the limb is rather slightly widened and is supported by rather broad chitinous rings, which articulate with each other at the middle by processes, both on the medial and the lateral side. The rings situated more proximally on the limb have no such processes and are also narrower and often rather irregular. Near the point of the limb there is an oval of irregular chitinous pieces, moveably joined to one another and enclosing a longitudinal muscle consisting of four parts; this apparatus is apparently used to press the end combs against each other; cf. *A. Grimaldi* var. *vicina*, fig. 2; this apparatus is, however, often rather difficult to observe with certainty. There are a comparatively small number of cleaning bristles, never more than one on the same side of the same ring. Their number and position vary to some extent, but not so much that they cannot be used as characteristics of the species. Each cleaning bristle has a rather small number (from one to five were observed) of bells, cut off transversally; the tongue of its terminal bell is cut off rather obliquely. Proximally of the bells the cleaning bristles are bare. There are only two symmetrical end combs with teeth of a somewhat varying type; these teeth are characterized by the fact that they are always furnished with a larger or smaller number of fine or more or less coarse secondary teeth arranged in the shape of a feather.

Male: — This has sometimes rather fewer bells on the cleaning bristles.

Furca: — This has very slight or is sometimes even quite without sexual dimorphism.

Female: — The lamellae are short, their breadth is somewhat greater than their length. Each lamella is armed with from seven to ten claws, all well divided from the lamella. The anterior claw is comparatively long, the others decrease fairly uniformly in length posteriorly, the posterior ones are short and are shaped like bristles. A division into main claws and secondary claws is, at least in many cases, almost conditional; at least the five anterior ones must, however, be considered as main claws. The claws are rather weakly curved along the greater part of their length; distally, on the other hand, they are rather strongly curved. The posterior bristle-like claws are often rather strongly and irregularly curved; the type is shown in fig. 17, *A. Grimaldi*. Only one out of all the species investigated by me was characterized by another type of claws; cf. fig. 12, *A. aberrata*. The main claws are armed ventrally with two rows, one medial and one lateral, of short, strong, pointed teeth. In all the species of this genus described in this treatise a number of these teeth are of somewhat greater length; on each claw from

about four to ten such long teeth were observed, scattered, situated at about equal distances from one another; on the posterior main claws they become fewer and fewer and shorter and shorter; in some species, however, they are rather short even on the anterior claws. The main claws, at least the anterior ones, are furnished dorsally with short hairs. Claws nos. 2 and 3 are very finely serrated dorso-distally; I cannot say with certainty whether a similar serration occurs in all the species described in this treatise, as this part of the claws is often rather considerably worn. The posterior claws are finely pectinated. Sometimes the posterior claws are finely annulated and on account of this they are exceedingly like bristles; this character cannot, however, be used as a criterion in classifying the claws into main claws and secondary claws, as it varies, at least in a number of species; in some forms there seems to be no annulation at all. The lamellae often have short, fine hairs behind the claws.

M a l e: — In some species it has the same number of claws as in the female, in others it has slightly fewer. It is practically impossible to discover any division into main claws and secondary claws. The first claw is, at least in a number of species, somewhat more slender and somewhat more boldly curved than in the female. The equipment of teeth on the claws is somewhat weaker, especially on the first claw; this claw is almost entirely unarmed; its distal quarter is even quite smooth.

The u p p e r l i p is small and has two lobes; cf. G. O. SARS, 1887, pl. V, figs. 4 and 5. It has a very small field of glands.

The r o d - s h a p e d o r g a n is rather long, of moderate breadth and rounded distally; its shape is somewhat irregular, most often somewhat broader at the middle; unjointed. In most of the species described below of about the same type as that reproduced in fig. 11 for *A. Ohlini*.

The l a t e r a l e y e s are most often well developed; see below, *A. abyssicola*.

G i l l s: — These are of quite the same type in all the species I have investigated. Cf. G. O. SARS, 1887, pl. VI, figs. 6 and 7. There are fourteen of them, seven in each row. They are all of about the same type, rather long and broad lamellae, of uniform width and more or less well rounded distally.

Special terminology: — S h e l l: — The list inside the posterior margin of the shell is called „the spine-bearing list".

For the terms for the distal bristles of the f i r s t a n t e n n a see the special terminology of the family.

M a n d i b l e: — T h e s c y t h e - s h a p e d p r o c e s s: The spine which is directed proximally on the distal part of the ventral margin and which is characterized by the fact that it is continued on the lateral side of the process by a low, bow-shaped ridge, armed, like the spine, with a close series of stiff, rather short hairs, is called „the main spine". The protuberances and spines on the ventral edge proximally of the main spine are called „ventral spines". The serrate teeth of the dorsal edge are called „the dorsal serrate teeth". The bristle distally of these serrate teeth is called „the dorsal bristle". The b a c k w a r d p o i n t i n g p r o c e s s: The three or four bristles situated distally on this process, which are characterized by the fact that their secondary spines become weaker and weaker distally are called „the

distal bristles". The bristles whose distal pair of secondary spines are more powerful than the proximal ones are called ,,triaena bristles". The short, weak bristles are termed ,,dwarf bristles". Bristles on the anterior edge of the second endopodite joint: The four long powerful bristles are called ,,main bristles" and are denoted proximo-distally by the letters a—d. The bristles situated proximally of the main bristle a are denoted as ,,proximal bristles". The row of cleaning bristles within the c-bristle is called ,,the lower row". The cleaning bristles in this as well as in the other rows are always counted from front to back. The anterior bristle of the end joint is called ,,the end claw".

Maxilla: — Medial bristles of the protopodite: The bristle situated dorsally, just in front of the fastening of the epipodial appendage, is called ,,the dorso-proximal bristle". The bristle or bristles situated dorsally on the distal part of the basale are called ,,the dorso-distal bristles". The bristle or bristles situated ventrally, at about the middle of the basale, are called ,,ventral bristles". The short bristle, situated somewhat distally of this bristle (these bristles), is called ,,the short ventero-distal bristle", to distinguish it from the long bristle that issues ventero-laterally on the distal boundary of this joint, which is called ,,the long ventero-distal bristle".

Sixth limb: — The bristles situated along the anterior edge of the anterior sole-shaped flattened part of the ventral side are called ,,the anterior ventral bristles", the other ventral bristles are called ,,the posterior ventral bristles".

The number of the joints of the first antenna.

Remarks: — The literature is not clear as to the number and the boundaries of the joints of the first antenna. In most cases no information is given on these points; and the writers who do deal with these questions make statements that contradict each other. It is certainly true that variation in these characters does occur in the genus, but these contradictions seem to be due, mostly if not entirely, to mistakes of one kind or another on the part of the authors.

I shall first give rather cursorily some indications of mistakes made with regard to the boundaries between the joints, which have caused statements that are certainly incorrect to be made about the number of bristles that is characteristic for each joint. Most writers give no or practically no information in the text as to the number and position of the bristles. To judge from their figures, however, it would appear that rather considerable variations existed within the genus. Thus G. O. SARS, 1887, p. 18, states in his genus description that the joint next to the distal one on the female first antenna is armed with a powerful claw and also with a pair of narrow, annulated bristles, the end joint would have four annulated bristles, furnished with sensorial filaments on one edge. The a-claw and the e-bristle would thus belong to the sixth joint. The same author writes on p. 12 in the description of the genus: ,,articulo penultimo in utroque sexu ungue forti antice curvato armato". Although G. W. MÜLLER states in his genus diagnosis, 1894, p. 217, that the a-claw belongs to the distal joint and gives in the accompanying figures an exposition of the number and position of the bristles on this limb that is on the whole quite correct, subsequent authors make mistakes, all the same, with regard to these things. Thus G. S. BRADY and A. M. NORMAN write, 1896, p. 628, in the diagnosis of the family, ,,penultimate joint in both sexes furnished with an unguis" an expression

that is, however, directly contradicted by the three figures of the female first antenna given by these writers, pl. L, figs. 3 and 8, pl. LIX, fig. 19. In one figure of the male first antenna, pl. L, fig. 2, the a-claw is drawn as if it issues from the next to the distal joint. In pl. L, fig. 8 no less than four bristles issue distally on the sixth joint. — J. A. CUSHMAN, who is the only author besides G. W. MÜLLER who has recently given reproductions of this limb, also makes mistakes with regard to the position of the end bristles; cf. 1906, pl. 29.

I have found the conditions with regard to the number of joints on the female first antenna to be very clear in all the species I have investigated. As will be seen from the information given above, I found six or seven joints, according to whether the third and fourth joints were free or were united to each other. Previous writers have, on the whole, given quite correct information with regard to this. The only important remark that can be made is that some of them have been too quick to generalize; they have adopted in their genus diagnoses what they discovered in the few species they were able to investigate. Thus G. O. SARS, 1887, p. 18 states in his genus diagnosis that the female first antenna always has six joints. — G. W. MÜLLER writes, 1894, p. 217, that the first antenna is „6- oder 7-gliedrig, beim ♂ Glied 7 + 8 oder 5 + 6, 7 + 8, oder auch 6 + 7 + 8 verschmolzen". But, to judge from pl. 4, figs. 14 and 30, the latter part of this statement „oder 5 + 6, 7 + 8, etc." refers to forms that turned out later not to belong to this genus. — G. S. BRADY and A. M. NORMAN, 1896, do not include the number of joints in their genus diagnosis; in the descriptions of the species, on the other hand, they give quite correct information about it.

The number and boundaries of the joints on the male first antenna is, on the other hand, very difficult to ascertain with certainty. And the statements of previous authors on these points vary considerably. No quite correct information seems to have been given so far.

G. O. SARS states, 1887, p. 18 that the male first antenna has eight joints, as the third and fifth joints of the female have each in the male been divided into two joints by an oblique suture. This author takes as the eighth joint a small part on which are situated the four end bristles that are furnished with sensorial filaments, a part that would be homologous with the small end joint in the female. — According to G. W. MÜLLER, 1894, p. 217 are „beim ♂ (stets?) 5 + 6 verschmolzen, die übrigen Glieder getrennt". In other words the male first antenna would have seven joints, with the original seventh and eighth joints free. The end joint, i. e. the original eighth joint, is relatively large and has all the seven distal bristles on it; cf. pl. 4, fig. 15. Information contrary to this exposition is given in the same work, p. 23; it is there stated in the table that the male first antenna has seven joints, with the fourth and fifth joints joined together. — In G. S. BRADY and A. M. NORMAN we find direct information as to the number of joints in the male first antenna only in the description of one species, *A. Mariae*. This species is said, p. 632, to have six joints in its first antenna. The text shows that these writers take the fourth and fifth joints as one joint, as the sensory bristle of the fifth joint is given, p. 633, as being on the fourth joint „fourth joint . . . . at the extremity below, a very large sensory organ". The accompanying figure, pl. L, fig. 2, shows, however, seven distinct joints, the fourth and fifth joints are well divided; all the end bristles issue from the moderately large end joint except the a-claw, which is attached antero-distally on the next to the distal

joint. One can understand indirectly from the text that these authors considered that the conditions were the same in the other male investigated by them, the male of *A. teres.* – Finally I wish to mention in passing that J. A. CUSHMAN, 1906, p. 366 states that the „last joint of antennula in male 3-jointed". As this statement does not even agree with the figures given by this author, pl. 29, figs. 21 and 22, it may be disregarded here. It ought perhaps also to be mentioned that the figures in question are not correct either.

As is shown by the description of the genus given above the facts ascertained by me do not agree with any of the preceding authors' accounts. All the males of this genus* that were investigated by me had a seven-jointed first antenna, the original third and fourth joints were always differentiated; the boundary between the fifth and sixth joints was sometimes, however, at least partly, not distinctly developed. The part on which the (d-), e-, f- and g-bristles are fixed ought perhaps to be distinguished as a special eighth joint (see p. 449 above).

A more detailed study of the structure of the first antenna seems to show with all desirable clearness the incorrectness of G. O. SARS's view that the fifth (i. e. the original sixth) joint of the female first antenna should in the male be divided into two joints and that the small part of the male first antenna on which the b-, e-, f- and g-bristles are situated corresponds to the whole of the little end joint of the female first antenna.

The small end joint of the female first antenna is moved by three muscles, namely one extensor and two flexors. The extensor is attached proximally at the anterior part of the boundary between the fourth and fifth joints, distally on the end joint anteriorly and somewhat laterally. Of the two flexors one arises posteriorly at the boundary between the third and fourth joints, and is attached distally on the end joint posteriorly and somewhat laterally; the other arises posteriorly at the medial boundary between the fourth and fifth joints, and is attached distally on the end joint somewhat medially. In addition there is a very weak, almost completely reduced flexor, arising posteriorly at the lateral boundary between the fourth and fifth joints, and fixed distally on the end joint posteriorly and somewhat laterally, in most cases a little in front of the flexor that arises posteriorly at the boundary between the third and fourth joints; cf. fig. 10 of *A. Grimaldi.* The seventh joint of the female first antenna is moved by quite the same muscles in all the species belonging to the sub-family *Cypridininae* that have been examined by me. These muscles are also found on the male first antenna in the family *Asteropidae.* The only differences are that the proximal fastenings of the two flexors that arise on the boundary between the fourth and fifth joints are displaced somewhat anteriorly and that the lateral of these two muscles is much more strongly developed. These four muscles do not, however, move the small part that G. O. SARS has homologized with the female end joint, but the large joint that I have described above as homologous with the female seventh joint; cf. fig. 11 of *A. Grimaldi.* Another reason against the assumption put forward by G. O. SARS that the original female sixth joint has been split into two joints in the male may possibly be considered superfluous, but I shall, however, state it here. There is always a bristle distally-medially on this joint in the female first antenna (in this genus as in the family *Cypridinidae*). The same

* Besides the males of *A. Grimaldi, norvegica* and [illegible] I investigated another male of this genus which is not included in this publication; the result was the same as for the three species mentioned.

bristle is also to be found on the male first antenna. This bristle is situated near the distal bristles in the female, because of the smallness of the end joint, but in the male it is rather far removed from these bristles. It is certain that we are not concerned here with a displacement of this bristle, as in the male, just as in the female, it is situated distally on the sixth joint; on the contrary its removal from the other bristles is due to the strong development of the end joint. If G. O. SARS's assumption that the original female sixth joint had been split were correct, it is clear that this bristle ought still to be situated close to the end bristles; in order to reach its present place it must have shifted right across the joint that G. O. SARS describes as the seventh, a phenomenon that seems anything but probable.

Nor is the small part that G. O. SARS denoted as the end joint homologous with the part that I showed above ought perhaps to be distinguished as a special, an eighth, joint. According to G. O. SARS the former part carries the b-, c-, f- and g-bristles. The latter part, on the other hand, has the (d-), e-, f- and g-bristles. The latter part is moved in the male by two very strong muscles, fixed proximally at about the boundary between the sixth and seventh joints. These muscles have no homologon in the females of this genus. On the other hand the eighth joint of the first antenna of all the species belonging to the sub-family *Cypridininae* that I had an opportunity of investigating closely is moved by two muscles which are certainly homologous with these. In this sub-family as well these muscles arise on the boundary between the sixth and seventh joints, but, on account of the comparatively smaller size of the seventh joint they are not inconsiderably smaller.

It follows from this that G. W. MÜLLER's idea of the male end joint, quoted above, is also incorrect. — Nor can this author's statement that the fifth and sixth joints of the male first antenna are always united be correct either, as is shown by the genus description I have given above; for all the species investigated by me had these joints free. But it does not seem impossible, however, that in some species of this genus these two joints are joined into one. This view is supported first by the fact that the boundary between these joints is sometimes, at least partly, rather weakly developed, secondly that the sixth joint is not moved by any special muscles. It is, however, to be noted that G. W. MÜLLER's own figures, both those in his large monograph of 1894 and others as well, directly contradict his statement. I shall only point out here that in pl. 4, figs. 15 and 17, of the mentioned work the boundary between these two joints is very well drawn, although on the former the boundary between the fourth and the fifth and on the latter the boundaries between both the fourth and the fifth joints on the one hand and the sixth, seventh and eighth joints on the other are not drawn. As far as this writer's statement, 1894, p. 23 that the fourth and the fifth joints are always joined in the male first antenna is concerned, this seems to be exceedingly problematical. In the first place I have always found these two joints well divided from each other on the species investigated by me, and secondly the fifth joint is moved by no less than three special muscles.

From what has been said above it also follows that G. S. BRADY's and A. M. NORMAN's information, 1896, is not quite correct.

[illegible]

A number of facts show the correctness of the homologization of the various distal bristles on the first antenna of the male and the female which has been adopted above. It may of course

seem curious, as regards the two strongly lengthened bristles in the male, that they should be homologized with the ventral of the two longest bristles in the female and the comparatively short bristle, which points forward almost at a right angle, of this sex. At the first glance it may perhaps seem more reasonable to assume that the two longest bristles in the male correspond to the two longest bristles in the female. The following three reasons may be given in support of the former explanation. In the first place the relative position of the bristles. As is shown by a comparison between the strongly magnified part of the male and female first antenna reproduced for *A. norvegica* (figs. 7 and 8), the two strongly lengthened bristles of the male (denoted by e and f) have quite the same position as the posterior of the two longest bristles and the bristle that is pointed forward at about right angles on the same limb of the female; the former is situated posteriorly on the joint, the other laterally somewhat behind the strong end claw. An argument that is perhaps still stronger is to be obtained from embryology. During the last larval stage the male and the female first antennae are of almost precisely the same type; dimorphism can, however, be observed in three bristles. Two of these, the one situated farthest back on the joint and the one situated laterally on the joint somewhat behind the strong end claw have, it is true, the same orientation as the correspondingly situated bristles on the first antenna of the mature female, but are somewhat longer comparatively and are, in addition, characterized by a very marked increase in the number of the sensorial filaments; cf. fig. 12 of *A. Grimaldi*. The remaining one of these three bristles, the one that has the same position as the anterior one of the two longest bristles of the mature female, has scarcely increased in length and is distinguished by a very slight increase in the number of sensorial filaments. While the latter bristle in the mature female is of quite or practically quite the same type as the posterior bristle on this joint, it is thus in the male, even at this stage, of a type differing exceedingly from it. On the other hand the posterior bristle on the joint and the bristle that points forwards at right angles are both modified in the same direction in this male larva. (Such a modification of these bristles can, as a matter of fact, be already traced in male larvae in stage II, but not earlier. The female larvae, on the other hand, do not show any modification of this sort at all; they are, on the contrary, very close to the type of the mature female.) Finally a third reason: As is shown by the description of the genus given above, the bristle that points forward at right angles on the first antenna of the female is characterized by the fact that its sensorial filaments issue from the posterior (-ventral) side of the bristle, while all the other distal bristles on this antenna are distinguished by the fact that their sensorial filaments issue along the anterior side. In the mature male too only one of the distal bristles has sensorial filaments along the posterior side; this bristle is the anterior of the two strongly lengthened bristles. This is naturally a rather strong argument in favour of the homologization of the bristle that points rectangularly forward in the female with the anterior of the two strongly lengthened bristles in the male. The homologization of the four (five) other distal bristles scarcely seems to need any additional reasons. The situation of these bristles is quite identical in the two sexes and even the difference in type is only very slight.

As appears from the genus description given above the exopodite of the second antenna is distinguished in the forms of this genus examined by me by marked dimorphism. This organ

is in these forms considerably more strongly developed in the male and in addition differences are to be observed in the proportions of the joints, in the development and equipment of the bristles and in the basal spines, etc. This dimorphism seems presumably to be characteristic of the genus as a whole. The fact that it has not been properly pointed out before is probably due to the rather superficial nature of previous investigators' observations. It is certainly true that G. S. BRADY points out as early as 1868 b, p. 464, that the second joint on the exopodite of the male second antenna is relatively longer than the corresponding joint in the female; this statement is not found, however, in later works by this author. Of the other writers there is only G. O. SARS, 1887, p. 20 who points out the existence of dimorphism: „Idethele er Svømmeantennerne hos Hannen kjendelig kraftigere udviklede end hos Hunnen, skjøndt, naar undtages Bigrenen, af et temmelig overensstemmende Udseende"*.

With regard to the endopodite of this antenna G. O. SARS, 1887, p. 19 states that this branch is characterized by two bristles in the female, one the comparatively long end bristle and the other a short bristle situated distally on the second joint. In a few cases a similar short bristle has also been observed by me on the second joint, as will be seen from the descriptions of the species given below; the bristle in question is then attached at about the same place as that where this joint of the male endopodite has three short bristles; it is presumably to be considered as an abnormally appearing homologon to one of these bristles. There is no question of any genus character.

I might also point out in passing the abnormal type of the endopodite of the female second antenna that is reproduced on fig. 10 of *A. norvegica* and whose resemblance to the male endopodite during the second larval stage is striking. In this type, which has been observed, as a matter of fact, in other forms within the *Cypridiniformes*, though only very seldom, we perhaps have a proof of the homology of the distal bristle on the female end joint with the proximal bristle on the same joint in the male.

In all the species of this genus that were investigated by me the epipodial appendage of the maxilla was of about the same relative size and type. In the genus description given by me this organ has also been stated to be of about the same type and relative size throughout the whole genus. All the reproductions of this organ that occur in the literature also show the same size and type as was observed by me, with, however, one exception, G. W. MÜLLER's drawing, 1894, of *A. teres*, pl. 5, fig. 15. In this figure this organ is drawn considerably smaller than I found it and its type is also somewhat different. I did not make any reservation for this species in my general genus description because there seemed to me to be strong reasons to believe that G. W. MÜLLER had made a mistake on this point either by drawing incorrectly or by taking an abnormal specimen as a type for the species. As will be seen from the remark under the species *A. Mülleri* described below, one specimen of this species from the Gulf of Naples, determined by G. W. MÜLLER as *A. teres*, had a maxilla with an epipodial appendage of quite the same type as I found in all the other species of this genus.

* On the whole the natatory antennae in the male are obviously more powerfully developed than in the female, though, with the exception of the endopodite, they agree fairly well in appearance.

The distal parts of the baleen bristles are drawn by G. W. MÜLLER differently from the type described and reproduced by me for the genus as a whole; cf. fig. 14 of *A. Grimaldi*. G. W. MÜLLER's drawing, 1894, pl. 5, fig. 15 a, is made from *A. teres*. An examination of a specimen of this form showed it to have the type described by me; on account of this I have assumed that G. W. MÜLLER has made a mistake on this point as well and have consequently made no reservation in this character for this form in the genus diagnosis given above.

Fifth limb. As is pointed out in the description of the genus given above, the large lateral bristle on the comb of the fifth limb extends with its point somewhat beyond the anterior end of the comb in all the forms investigated by me. G. W. MÜLLER draws this bristle (1894) in *A. oblonga* as not inconsiderably shorter relatively, pl. 4, fig. 50; in another figure of the same species, pl. 4, fig. 49, this bristle is reproduced with the same relative length as I observed in the species investigated by me. On examining a specimen from the Gulf of Naples, identified by G. W. MÜLLER as *A. oblonga*, the same condition was observed as in pl. 4, fig. 49; because of this I considered it probable that fig. 50 is incorrectly drawn in this character and have therefore made no reservation for this species in the above genus description.

Furca. In the key that G. W. MÜLLER set up for this genus, 1912, p. 43 we find in no. 5 the following statement: „Am 1. und 2. Furcaldorne finden sich zwischen den dicht stehenden kurzen Spitzen längere Borsten in geringerer Anzahl (5 resp. 3)." This character would distinguish only a single species, *A. quadrata* G. S. BRADY. This is certainly a mistake on the part of this writer, as these „longer bristles" are undoubtedly no specific character for this species; on the contrary they are certainly identical with the long ventral spines that are shown in the above description of the genus to be characteristic of the females of all the species of this genus that were investigated by me. Similar long spines have, as a matter of fact, been reproduced by G. W. MÜLLER himself; cf. 1894, pl. 5, fig. 23.

Classification of Asterope. The genus *Asterope*, in the sense that it is taken in the present work, seems to be a very natural systematic unit.

Is an additional division of this genus possible and proper?

A number of the species described by me below may fairly naturally be arranged in smaller and presumably natural groups, and some occupy a more or less isolated position. It seems to me, however, rather inconvenient to look upon these groups as special sub-genera, first because we are concerned with rather small differences and secondly because, in my opinion, these groups will probably prove to be very difficult or even quite impossible to distinguish when in the future the number of well investigated and described species is increased. So far I have distinguished three groups, which I shall subsequently call:

1) the *Quinquesetae* group
2) „ *Mülleri* „
3) „ *Grimaldi* „

With reference to the descriptions of the species given below I shall give a brief account here of the characters that distinguish these groups:

Quinquesetae group:

Female: — Shell: — Seen from the side this is somewhat oblong, more or less weakly pear-shaped, with the posterior part rather slightly larger than the anterior part.

F i r s t a n t e n n a: — The sensory bristle of the fifth joint has seven sensorial filaments. Its end joint has seven bristles, as both the d- and the e-bristle are well developed (the d-bristle is, however, distinctly weaker than the e-bristle).

M a n d i b l e: — Protopodite: First joint: The rod-shaped process of the endite has three or four short, powerful spines distally. Second joint: The backward pointing process: The triaena bristles have relatively numerous (5—15 pairs) secondary spines proximally of the distal pair of spines. Two dwarf bristles are developed on this process. On the middle of the dorsal side of this joint there are a number of bristles. Endopodite: The second joint has from two to four proximal bristles and one long, narrow bristle, with short, fine hairs, between the b- and c- main bristles.

S e v e n t h l i m b: — This has rather numerous cleaning bristles. The teeth of the end combs are finely and evenly pectinated.

The m e d i a n e y e is bare.

The m a l e is unknown.

To this group belong — at least with complete certainty — only two of all the species so far described; these are described by me below:

A. quinquesetae and

,, *spinifera.*

For *A. australis*, G. S. BRADY, 1890, cf. remark under *A. spinifera*, p. 483 below.

Mülleri g r o u p:

F e m a l e: — S h e l l: — Seen from the side, this is rather high and short, somewhat pear-shaped, with the posterior part rather strikingly larger than the anterior one.

F i r s t a n t e n n a: — The sensory bristle of the fifth joint has six sensorial filaments. Its end joint has only six bristles, as of the d- and e-bristles only the latter is well developed, the former being represented by a very small verruciform process.

M a n d i b l e: — Protopodite: First joint: The rod-shaped process of the endite is furnished distally with three short, fine points. Second joint: The triaena bristles of the backward pointing process have rather few (from one to six pairs) of secondary spines proximally of the distal pair of spines. Only one dwarf bristle is developed on this process. There are no bristles at all on the middle of the dorsal side of this joint. Endopodite: The second joint has one proximal bristle and one long, narrow bristle, with short, fine hairs, between the b- and c-main bristles.

S e v e n t h l i m b: — This has twelve cleaning bristles, six of which are situated near the point of the limb, three on each side and six somewhat proximally of these. The teeth of the end combs are variously equipped, the most distal ones having considerably stronger and fewer secondary teeth than the proximal ones.

The m e d i a n e y e has short, fine hairs.

The m a l e s are practically unknown. According to a statement of G. S. BRADY's, however, at least one species has abundant sensorial filaments on the sensory bristle of the fifth joint of the first antenna.

The following species of those investigated by me belong to this group:

A. Mülleri.

,, ,, var. *longiseta.*

,, *Ohlini.*

The form *A. curta* described below also seems to be closely related to this group. In some characters, however, it occupies a special position:

Female: — First antenna: — On the anterior side of the third joint there are only five bristles (six in the former species). Mandible: — The backward pointing process on the second protopodite joint has two dwarf bristles. The seventh limb has more than twelve bristles; the teeth of the end combs are evenly and finely pectinated. Male: — The first antenna has only six sensorial filaments on the sensory bristle of the fifth joint.

For the relation to this group of the following species not investigated by me see pp. 488—490, the remark under *A. Mülleri*: *Cypridina teres*, A. M. NORMAN, 1861, *Cylindroleberis teres*, G. S. BRADY, 1868 b, *Asterope oblonga* och *ovalis*, C. CLAUS, 1876, *Cylindroleberis teres*, G. W. MÜLLER, 1894, *Asterope teres*, G. S. BRADY and A. M. NORMAN, 1896 and *A. oculata*, G. S. BRADY, 1902 a.

A. glacialis is very closely connected to *A. curta*; cf. the remark under the latter species.

Grimaldi group:

Female: — Shell: — Seen from the side it is more or less elongated, with the posterior and anterior parts of about the same height.

First antenna: — The sensory bristle of the fifth joint has seven sensorial filaments. Its end joint has only six bristles, as of the d- and e-bristles only the latter is well developed, the d-bristle being represented only by a very small verruciform process.

Mandible: — Protopodite: First joint: The rod-shaped process of the endite has three short powerful spines distally. Second joint: The backward pointing process: The triaena bristles have rather few (from two to five pairs) of secondary spines proximally of the distal pair. Two dwarf bristles are developed on this process. On the middle of the dorsal side of this joint there is usually one, but sometimes no or two bristles. Endopodite: The second joint has one proximal bristle and has no long, narrow bristle, with fine, short hairs, between the main bristles b and c.

Seventh limb: — This has twelve cleaning bristles, six of which are situated near the point of the limb, three on each side, and six somewhat proximally of these, three on each side. The teeth of the end combs are evenly and finely pectinated.

The median eye is bare.

Male: — The first antenna has numerous sensorial filaments on the sensory bristle of the fifth joint. For other examples of dimorphism see the descriptions of the species.

The following species of those investigated by me belong to this group:

A. Grimaldi

,, ,, var. *vicina*

,, *oculata*

,, *norvegica.*

A. abyssicola is also very closely related to this group. It differes from it, however, in a number of characters: Mandible: — The second endopodite joint has two proximal

bristles. The seventh limb has more than twelve bristles. In addition this species differs from other known forms of this genus in being quite without lateral eyes.

Of those species that I have had no opportunity of investigating myself *A. inermis*, G. W. MÜLLER, 1906 b, seems to be very closely related to this group.

For the relation to this group of the following species that have not been investigated by me see the remark on *A. Grimaldii*: *Cypridina Mariae*, W. BAIRD, 1850 c, *C. oblonga*, E. GRUBE, 1859, *Cylindroleberis Mariae*, G. S. BRADY, 1868 b, *Asterope oblonga*, G. O. SARS, 1887, *Cylindroleberis oblonga*, G. W. MÜLLER, 1894, *Asterope Mariae*, G. S. BRADY and A. M. NORMAN, 1896, *Cylindroleberis Mariae*, J. A. CUSHMAN, 1906, *C. Mariae*, CH. JUDAY, 1907, *C. oblonga*, R. W. SHARPE, 1909.

The only species among those described below that has not been mentioned so far, *A. aberrata*, occupies a somewhat isolated position. It seems to be most closely related to the *Mülleri* group.

The characters in which it differs from this group are as follows: —

The elliptical shape of the shell.

First antenna: — The marked reduction of the third and fourth joints.

Mandible: — Second protopodite joint: The backward pointing process: The triaena bristles have from five to eleven secondary spines proximally of the distal pair of spines. Two dwarf bristles are developed on this process. At the middle of the dorsal side of this joint there is one bristle.

The sixth limb, unlike that of other known forms, has no posterior ventral bristles.

The seventh limb has less than twelve bristles. The teeth of the end combs are finely and uniformly pectinated.

A. elliptica, G. O. SARS, 1887 is probably rather closely related to this form. As to the position of *A. elliptica*, A. PHILIPPI, 1840 see below p. 509.

With regard to the systematic position of those of the species not investigated by me that have not so far been mentioned I shall not try to put forward any opinion, as, on account of the incompleteness of the descriptions, this would be so uncertain that its scientific value would be exceedingly small.

most primitive?

Which of the species so far known are to be considered the most primitive?

At the present moment this question can scarcely be discussed. It can only be said that in one respect — the development of the d-bristle on the first antenna — the *Quinquesetae* group is more primitive than the others. Whether it is also to be considered as more primitive in other characters cannot be decided with any certainty, though it does not seem to me to be impossible.

The first species of this genus to be described was *A. elliptica*, A. PHILIPPI, 1840. As this form — as is shown by the historical sketch, p. 433 — must be said to be unidentifiable as a species, it can scarcely be convenient to consider it as a type species for this genus. I suggest instead as the type species *A. elliptica*, G. O. SARS, 1887, a species of which, it is true, we cannot say with absolute certainty that it is identical with the form described by PHILIPPI, but which is, however, presumably very closely related to it. (G. W. MÜLLER makes this identification, 1912, p. 46, but adds a query.) The form described by G. O. SARS certainly needs to be re-described, but it must be denoted as one that is identifiable as to its species. It may be noted that the type-specimen of this form — according to a written communication to me from Professor

G. O. SARS — has unfortunately been lost. It seems to me rather probably that in describing this species G. O. SARS has not confused two forms, as G. W. MÜLLER seemed inclined to believe at first — cf. G. W. MÜLLER, 1894, p. 218.

Key to the species described in this treatise (applies also to the males investigated by me):

1.	The end joint of the first antenna has seven bristles, two simple sensorial filaments, d- and e-bristles. — 2.	
	The end joint of the first antenna has six bristles, only one simple sensorial filament, the e-bristle, is developed, the d-bristle verruciform. — 3.	
2.	The first endopodite joint of the mandible is furnished antero-distally with powerful chitinous spines.	*A. spinifera.*
	The first endopodite joint of the mandible has no powerful chitinous spines at all.	*A. quinquesetae.*
3.	The second endopodite joint of the mandible has a long, narrow bristle, with short, fine hairs, between the b- and c- main bristles. The sensory bristle of the fifth joint on the female first antenna has only six sensorial filaments. — 4.	
	The second endopodite joint of the mandible has no such bristle between the b- and c- main bristles. The sensory bristle of the fifth joint on the female first antenna has seven sensorial filaments. — 8.	
4.	The sixth limb has no posterior ventral bristles.	*A. aberrata.*
	.. .. .. has .. .. .. — 5.	
5.	The (original) third joint of the first antenna has five bristles on the anterior edge.	*A. curta.*
	The (original) third joint of the first antenna has six bristles on the anterior edge. — 6.	
6.	The distal bristle of the endopodite of the second antenna is about as long as or only slightly longer than the endopodite. The second endopodite joint of the mandible has comparatively numerous cleaning bristles, seven in a distinct lower row, from five to eight in a distinct upper row.	*A. Ohlini.*
	The distal bristle of the endopodite of the second antenna is twice or more than twice as long as the endopodite. The second endopodite joint of the mandible has comparatively few cleaning bristles, five or six in a distinct lower row, two or three in an upper row. — 7.	

7. Maxilla: The dorso-distal bristle on the basale is about as long as or a little shorter than the first endopodite joint. — *A. Mulleri.*
   „ The dorso-distal bristle on the basale is considerably longer than the first endopodite joint — *A. Mulleri* var. *longiseta.*

8. Without lateral eyes. — *A. abyssicola.*
   With well developed lateral eyes. — 9.

9. The exopodite of the mandible is more than half the length of the anterior side of the first endopodite joint. — 10.
   The exopodite of the mandible is considerably shorter than half the anterior side of the first endopodite joint. — 11.

10. Maxilla: The distal endite has three bristles, the basale has five dorso-distal bristles. — *A. norvegica.*
    „ The distal endite has four bristles, the basale has two dorso-distal bristles. — *A. oculata.*

11. The second protopodite joint of the mandible has a bristle on the middle of the dorsal side. — *A. Grimaldi.*
    The second protopodite joint of the mandible has no bristle on the middle of the dorsal side. — *A. Grimaldi* var. *vicina.*

Asterope quinquesetae n. sp.

Description: — Female: —

Shell: — Length 2,95—3,1 mm.; length : height about 1,75 : 1; length : breadth about 2 : 1. Seen from the side (fig. 1) it is rather elongated, with its greatest height somewhat behind the middle and the posterior part somewhat, though only slightly, larger than the anterior part. The dorsal and ventral margins are moderately and almost uniformly curved, with almost the same shape, but the dorsal margin is somewhat more flattened anteriorly than the ventral one; they pass evenly into the anterior and posterior margins without any corners. The anterior and posterior margins are uniformly and boldly, almost semi-circularly, rounded. The rostral incisur is situated rather considerably ventrally of half the height of the shell. Seen from beneath (fig. 2) the shell is rather narrow and egg-shaped, with its greatest breadth somewhat behind the middle; the posterior end is somewhat more broadly rounded than the anterior one, the side contours are evenly curved. Seen from inside: Medial bristles: On the rostrum there is a fairly distinct, moderately close, row of moderately long, stiff bristles, running somewhat within and about parallel with the anterior margin of the shell. Within this row there are usually only rather few scattered bristles on the rostrum; some of these bristles are moderately long, most of them, however, are very short; they vary somewhat in number. In the incisur there are rather numerous moderately long, stiff bristles, all quite without any definite arrangement. On the part

just behind the incisur there are rather few or a moderate number of scattered bristles, of which those that are situated near the margin of the shell are moderately long, those situated farther in more or less short. Along the middle part of the ventral margin of the shell there are a moderate number of long or rather short, stiff bristles, most of which are arranged in a rather distinct row running somewhat inside the ventral margin. Between the ventral half of the spine-bearing list and the margin of the shell there are rather numerous moderately long, stiff bristles, sometimes arranged in a more or less distinct row, running about parallel to and somewhat inside the margin of the shell, in most cases, however (as in the accompanying figure 3) arranged more or less irregularly. Dorsally of these bristles there are a moderate number of scattered, very short bristles right up to the dorsal boundary of the bristle-bearing list. About half-way between and parallel to the posterior margin of the shell and the dorsal half of the spine-bearing list there is a sparse row of six or seven broad pores; each of these pores is furnished with a freely projecting hyaline peg (I was unable to ascertain with certainty the shape of these pegs). The spine-bearing list is weakly undulated and is provided with about 32 to 35 hyaline spines, varying somewhat in size, and with a close row of stiff and rather short bristles, varying somewhat in length; on an average about three bristles were observed for each hyaline spine. Neither on the right nor on the left valve was there a sharp edge similar to that described and reproduced as characteristic of the posterior part of the right valve of *A. spinifera* (cf. this species, fig. 3).

F i r s t a n t e n n a (fig. 5): — This has six or seven joints; the third and fourth joints are sometimes free, sometimes more or less strongly united. These two joints form together one sub-rectangular joint, whose length is somewhat less than its height and rather considerably less than the total length of the two following joints. The distal boundary of the fourth joint is moderately concave. The anterior bristle of the second joint is about as long as the anterior side of this joint. The third joint has six anterior bristles. Of these nos. 5 and 6 and sometimes nos. 3 and 4 as well are situated at the side of each other. Bristles nos. 1, 2, 4 and 5 are armed ventrally with long, stiff secondary bristles; the secondary bristles on bristles nos. 3 and 6 are short and fine, often pressed rather close to the bristle, so that they are sometimes rather difficult to observe with certainty. The longer of the two postero-distal bristles of the fourth joint is somewhat longer than the fifth joint, but somewhat shorter, however, than the total length of the fifth and sixth joints. The stem of the sensory bristle of the fifth joint is about as long as or somewhat shorter than the total length of the third to the sixth joints; it is provided with seven sensorial filaments. The end joint has seven bristles, the d-bristle is developed, unlike in most of the species in this genus. The a-claw is decidedly longer than the anterior side of the two next distal joints and is smooth. The f-bristle has five sensorial filaments. The e- and g-bristles have six sensorial filaments. The d-bristle is in most cases considerably shorter and rather considerably more slender than the e-bristle. Pilosity: The first and second joints have abundant groups of short, exceedingly fine, stiff hairs — only just suggested in the adjoining figure — the antero-distal part of the second joint seems, however, to be always without hairs. There are no hairs along the distal boundary of this joint.

S e c o n d a n t e n n a: The p r o t o p o d i t e has distally a very short bristle on the inside close to the exopodite. The end joint of the e x o p o d i t e has four bristles

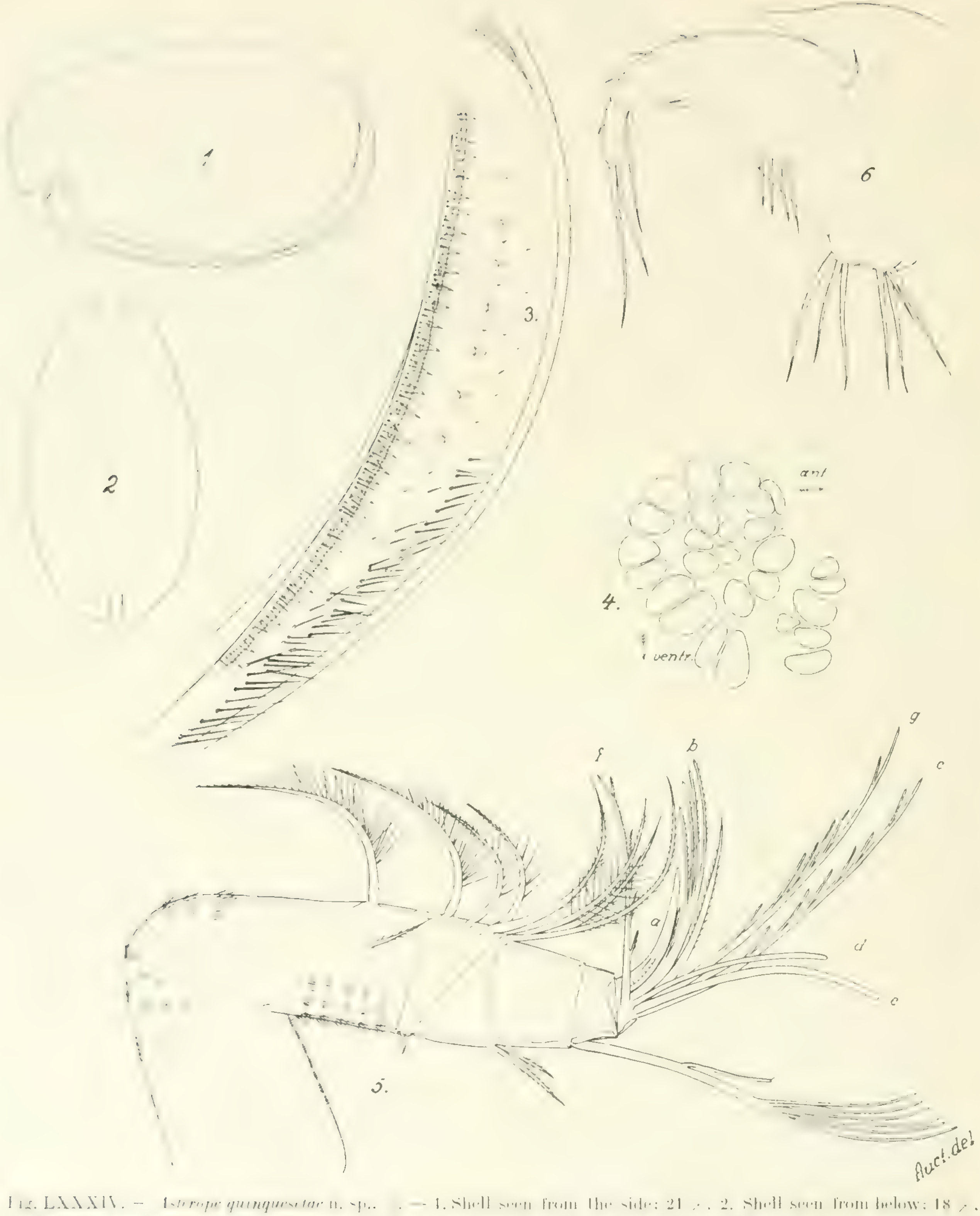

Fig. LXXXIV. — *Asterope quinquesetae* n. sp., — 1. Shell seen from the side: 21 ×. 2. Shell seen from below: 18 ×. 3. Posterior part of the right valve seen from inside: 105 ×. 4. The fixing spots of the shell muscle; right valve seen from outside: 110 ×. 5. Right first antenna seen from outside: 105 ×. 6. Right maxilla seen from inside: 115 ×.

The fourth to the ninth joints of this branch each have a basal spine. The endopodite is distinctly three-jointed; its distal bristle is slightly longer than the stem.

Mandible: — Protopodite: Coxale: The scythe-shaped process (figs. 8, 9): The part distally of the main spine narrows uniformly and gently into a fine point; its ventral edge is even and rather decidedly convex. The distance from the point of the process to the main spine is about as long as or somewhat longer than the distance from the latter to the proximal ventral spine. The dorsal bristle is fixed at about a similar distance from the point of the process as from the main spine and at a distance of about its own length distally of the latter; it extends only slightly distally of the point of the process. The dorsal serrate teeth are very weak; some are scarcely developed. The main spine is moderately strong. There are six ventral spines; of these the three proximal ones are rather strong, the distal ones sometimes rather weak; the distal one, or sometimes the two distal ones, is pointed proximally. On the part distally of the main spine there are seven or eight transverse rows of hairs. The rod-shaped process has three or four short, strong distal spines. Basale: The backward pointing process has four end bristles, three or four triaena bristles and two dwarf bristles. The triaena bristles have from three to fifteen pairs of secondary spines under the main pair of spines. The glands emerge on a rather weakly developed papilla (this papilla is weaker than in fig. 9 of *A. spinifera*). Dorsally at about the middle this joint has five rather short bristles, subequal or of somewhat different lengths, equipped on the anterior side with short, fine hairs (the species has derived its name from this character); close to these bristles there are groups of short, fine, stiff hairs (fig. 7). The exopodite is, if its two end bristles are included, about as long as or rather slightly shorter than half the length of the anterior side of the first endopodite joint (fig. 7). Endopodite (figs. 7 and 10): Of the three ventral bristles on the first joint the shortest has short, fine hairs, the two others are furnished with short secondary bristles proximally of the long secondary bristles; on one bristle about ten to fifteen, on the other about twenty to thirty pairs of similar short secondary bristles were observed. This joint is not armed with spines antero-distally. The second joint has two proximal bristles of somewhat different lengths; the longest is somewhat less than half the length of the main bristle a. Between the main bristles b and c there is a long narrow bristle with short hairs. The medial cleaning bristles are rather numerous and are arranged in two rather steeply descending rows. They vary to some extent; three specimens that were investigated showed the following conditions:

Type specimen: Right mandible	6 bristles in a distinct lower row.
	4 .. .. upper ..
	1 bristle above bristle no. 2 of the latter row.
	6 bristles in a distinct lower row.
.. .. Left ..	5 .. .. upper ..
	1 bristle above bristle no. 2 of the latter row.
	6 bristles in a distinct lower row.
Specimen no. 2. Right ..	5 .. .. .. upper ..
	1 bristle above bristle no. 2 in the latter row.

Specimen no. 2. Left mandible	7 bristles in a distinct lower row. 4 „ „ „ „ „ upper „ 1 bristle above bristle no. 3 in the latter row.
Specimen no. 3. Right „	7 bristles in a distinct lower row. 5 „ „ „ „ „ upper „ 1 bristle above bristle no. 3 of the latter row. 1 „ between the main bristles a and b.
„ „ Left „	9 bristles in a distinct lower row. 5 „ „ „ „ „ upper „ 2 „ above bristles nos. 1 and 2 of the latter row.

End claw very powerful, about as long as the anterior side of the second endopodite joint, smooth.

Maxilla (fig. 6): — Protopodite: The distal endite is armed with three bristles, the middle one of which is usually somewhat shorter than the other two. The dorso-proximal bristle is moderately long. The ventral bristles on the basale vary both with regard to number and position not only from one individual to another but even on the right and left maxillae of the same specimen; from four to seven of these bristles were observed; of moderate and somewhat varying lengths. In addition the basale has three subequal and rather short dorso-distal bristles. The short ventero-distal bristle of this joint is developed. Endopodite: The posterior distal bristle of the first joint is somewhat shorter than the bristle on the end joint.

Sixth limb — The posterior edge is rather well rounded, the posterior ventral corner is rather broadly rounded. There are 22—24 postero-ventral bristles and five or six antero-ventral bristles. On the anterior edge only one bristle, the upper one, is developed.

Seventh limb (figs. 11—13): — This is armed with 22—26 cleaning bristles of moderate and somewhat different lengths, scattered fairly regularly along the distal part of the limb. The number and position of these bristles vary both from one individual to another and from the right to the left limb of the same individual. Each cleaning bristle has from three to five bells. Each end comb consists of 17—19 teeth. All these teeth are of the same type, closely and evenly pectinated; they are strengthened distally; cf. fig. 13.

Furca: — This has eight or nine claws; of the three specimens investigated two had nine, the third, the type-specimen, had only eight, one of its secondary claws was absent, but I could not decide if the specimen in question was defective, which is, however, not improbable. Of these claws the six or seven anterior ones are to be denoted as main claws. The first and second main claws have no ventral basal teeth. One or two of the posterior secondary claws are annulated.

The lateral eyes are well developed. The median eye is smooth.

The male is unknown.

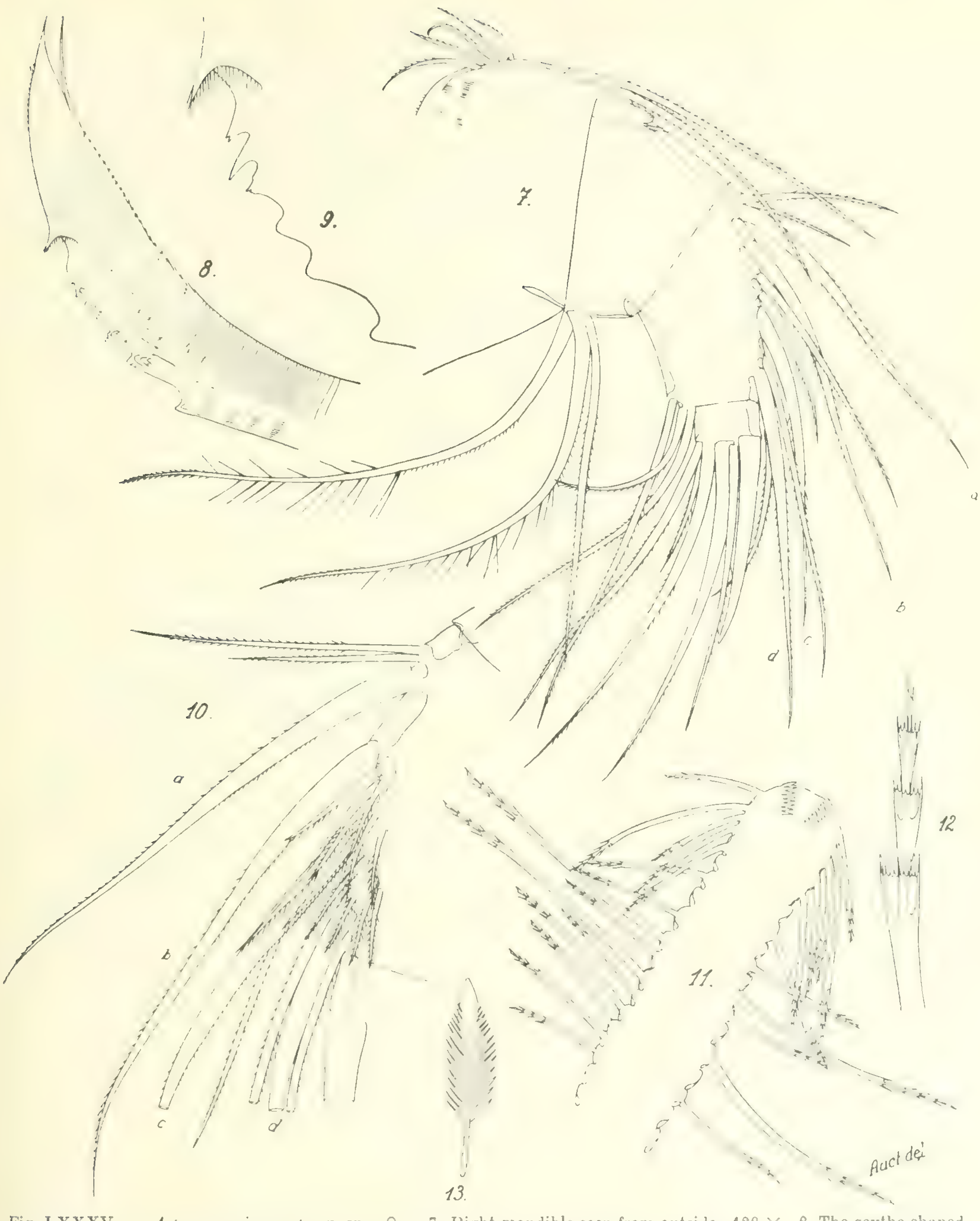

Fig. LXXXV. — *Asterope quinquesetae* n. sp., ♀. — 7. Right mandible seen from outside; 128 ×. 8. The scythe-shaped process; the rows of hairs on the concave side are only indicated, they extend across the process; 352 ×. 9. Ventral teeth of this process; 480 ×. 10. The anterior part of the second endopodite joint of the right mandible seen from inside; 212 ×. 11. Seventh limb; 147 ×. 12. Cleaning bristle of this limb (distal part); 680 ×. 13. Tooth of one of the end combs; 1480 ×.

Remark: — As will be seen below, I found, besides mature females, three female larvae as well of this species from station no. 34 of the Swedish „Antarctic" Expedition. Two of these larvae were 2,44—2,45 mm. long, the third was only 1,95 mm. If we assume — and the assumption is supported by anatomical investigation — that these two classes of length represent the two oldest larval stages, we obtain, by using BROOKS's law, a coefficient of growth of 1,25 (2,44 : 1,95 = 1,25). If 2,44 mm. then is multiplied by 1,25 we get 3,05 mm., a value which thus coincides with the length of the mature female.

Habitat: — South Georgia: S. A. E., Station 34, off the mouth of Cumberland Bay, lat. 54° 11′ S., long. 36° 18′ W. (type-locality); 5. VI. 1902; depth, 252—310 m.; grey clay with scattered stones; temperature at the bottom, + 1,45° C: 4 mature females and 3 juvenes; R. M. S. 162.

Type specimen on slides in the collections of the R. M. S.

Asterope spinifera n. sp.

Description: — Female: —

Shell: — Length 2,55—2,6 mm.; length : height about 1,5 : 1; length : breadth about 1,7 : 1. Seen from the side (fig. 1) it is of about the same type as the shell of the preceding species, from which it differs chiefly by having the posterior part dominating over the anterior one in a somewhat more striking way, by the dorsal and ventral margins being somewhat more strongly curved and by the rostral incisur being situated somewhat more dorsally. Seen from beneath (fig. 2) it is also of about the same type as the shell of the species just mentioned, but is somewhat broader comparatively. Seen from within: Medial bristles: Parallel to and somewhat within the anterior margin of the shell there is on the rostrum a distinct, moderately close, row of moderately long, stiff bristles. Within this row there are on the rostrum, in the incisur and on the part just behind the latter rather numerous stiff bristles, all scattered, most of them moderately long, a number, especially amongst those situated farthest in, more or less short. Along the middle part of the ventral margin of the shell there are a moderate number or rather numerous moderately long or rather short, stiff bristles, either scattered or arranged in a more or less distinct row running somewhat within the margin of the shell. From a point somewhat in front of the ventral boundary of the spine-bearing list this row of bristles is continued by a very close, distinct row of moderately long, stiff bristles, running about parallel to and somewhat within the margin of the shell up to about half the height of the shell, from where it is continued by a considerably more sparse row of rather short and weak bristles, which continue right up to the dorsal boundary of the spine-bearing list (fig. 3). Apart from these bristles there are usually no medial bristles on the part between the posterior margin of the shell and the spine-bearing list. The spine-bearing list has not an undulated edge and is provided with 35—38 hyaline spines of somewhat varying sizes and a very close row of rather short bristles of somewhat different lengths; about four to six bristles were observed for each

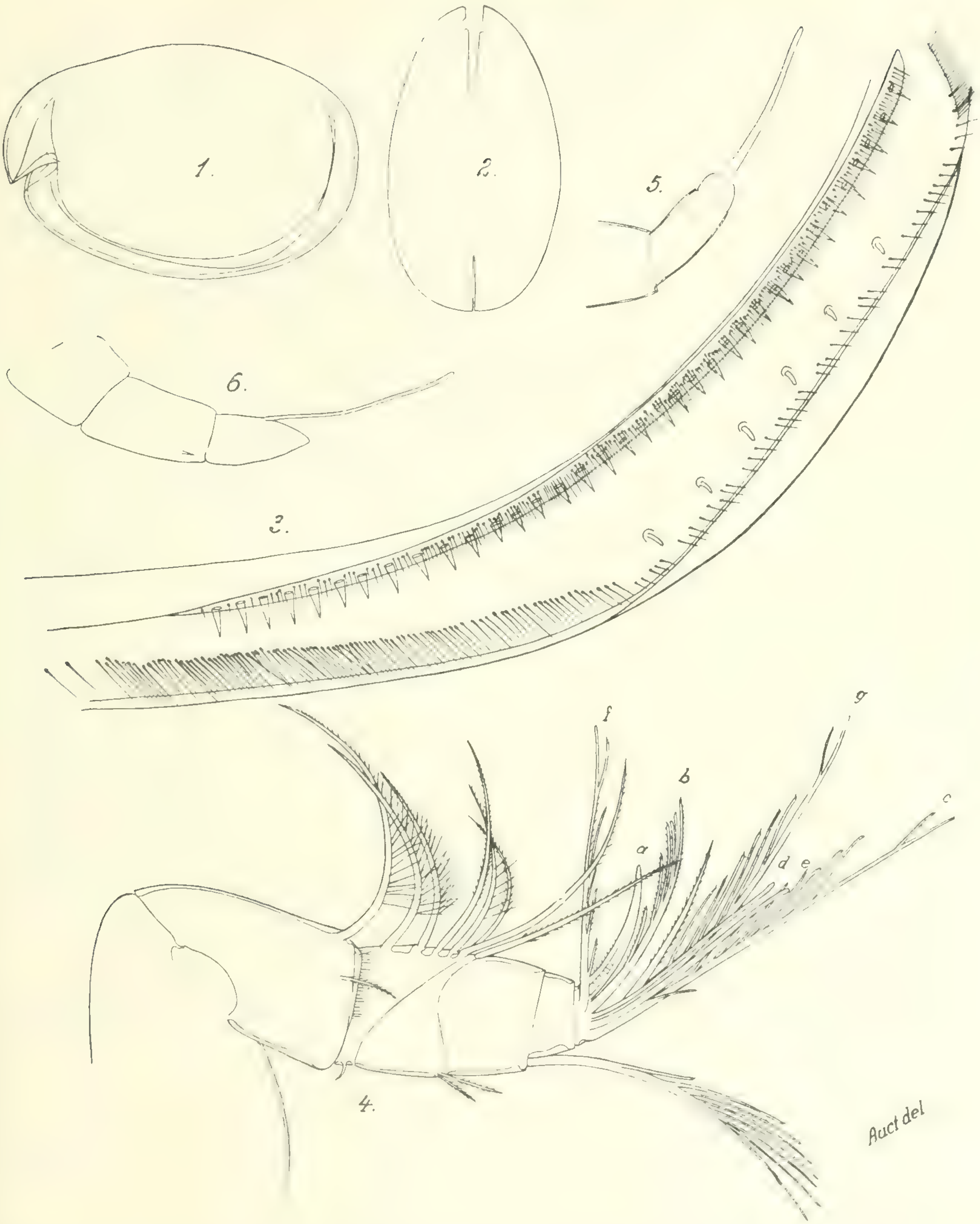

Fig. LXXXVI. — *Asterope spinifera* n. sp. — 1. Shell seen from the side, ♀; 23 ×. 2. Shell seen from below, ♀; 20 × 3. Posterior part of the right valve seen from inside; ♀; 137 ×. 4. Right first antenna seen from outside, ♀; 105 ×. 5. Endopodite of the second antenna, ♀; 230 ×. 6. Endopodite of the second antenna, ♂ Stage II; 312 ×.

hyaline spine. At about half way between and parallel to the posterior margin of the shell and the dorsal half of the spine-bearing list there is a sparse row of about six or seven broad pores; each pore is furnished with a freely projecting hyaline peg (the shape of these pegs could not be observed with certainty). Behind the dorsal half of the posterior medial row of bristles is seen in fig. 3 a double line running transversely over the shell; this corresponds to a sharp edge. The part between this and the posterior margin of the shell is situated rather considerably more laterally and thus, when it is looked at through the microscope from inside, rather considerably deeper than the part situated within the double line. This character is in most cases only distinctly developed on the right valve, as on the left valve this ridge is so near the margin of the shell that it often seems quite to coincide with the latter.

F i r s t a n t e n n a (fig. 4): — This has seven joints, the third and fourth joints are free from each other. These two joints together form a joint that is somewhat shorter than it is high and also somewhat shorter than the total length of the fifth and sixth joints. The distal boundary of the fourth joint is rather strongly concave. The anterior bristle of the second joint is somewhat longer than the anterior side of this joint. The third joint has six anterior bristles, of which nos. 5 and 6 are fixed at the side of one another. Nos. 1, 2 and 4 of these bristles are armed ventrally with long, stiff secondary bristles, the others have short hairs. The longer of the two posterior distal bristles on the fourth joint is not quite as long as the the fifth joint. Sensory bristle of the fifth joint: The stem is about as long as the total length of the third to the fifth joints; it is furnished with seven sensorial filaments. The end joint has seven bristles, the d-bristle is developed as in the preceding species but unlike all the other species of this genus in which this character is known. The a-claw is somewhat longer than the total length of the anterior side of the two next distal joints and is exceedingly finely and weakly pectinated proximo-anteriorly. The f-bristle has four or five sensorial filaments. The c- and g-bristles have a somewhat varying number of sensorial filaments: on the type-specimen the c-bristle had nine, the g-bristle seven on the antenna of the right side; on the antenna of the left side the c-bristle had seven, the g-bristle eight filaments; on two other specimens both these bristles had seven sensorial filaments on both the right and the left antennae. The d-bristle is somewhat more slender but rather slightly shorter than the e-bristle. Pilosity: The first and second joints have numerous groups of stiff, fine hairs on the greater part of both the inside and the outside (not drawn in the figure); there never seem, however, to be any such bristles on the anterior distal part of the inside of the second joint. Distally the second joint has a close row of short, stiff hairs antero-laterally.

S e c o n d a n t e n n a: — Distally on the inside close to the exopodite the p r o t o p o d i t e has one very short bristle. The e x o p o d i t e has four bristles on the end joint; the fourth to the ninth joints of this branch have basal spines. The e n d o p o d i t e is distinctly three-jointed; its end bristle is about as long as the stem (fig. 5).

M a n d i b l e: — P r o t o p o d i t e: Coxale: The scythe-shaped process (fig. 8): The part situated distally of the main spine grows uniformly and gently narrower in a fine point; its ventral edge is even, almost straight or even slightly concave. The distance from the point

of the process to the main spine is somewhat greater than the distance from the latter to the proximal ventral spine. The dorsal bristle is attached somewhat nearer to the point of the process than its distance from the main spine and about as far as its own length distally of the latter; it extends to a distance of almost half its length distally of the point of the process. The dorsal serrate teeth are rather large. The main spine is unusually powerfully developed. There are five or six ventral spines, in most cases rather strong, of which the two distal ones point proximally; the distal one of these spines is sometimes even of the same size and type as the main spine. On the part distally of the main spine there are only a few transverse rows of hairs, one or two were observed. The rod-shaped process has four short and powerful distal spines. Basale: The backward pointing process is of about the same type as in the preceding species (fig. 9), but four or five triaena bristles were observed and the glandular papilla was somewhat more powerfully developed. The dorsal side of this joint has about ten to twelve rather short bristles with short hairs (cleaning organs? they are often very dirty); these bristles are spread along almost the whole of the joint and between them there are numerous short, strong, pointed spines, arranged in groups; in addition there are dorsally on this joint groups of short, stiff hairs. The exopodite (fig. 7) is, even if its two distal bristles are included, somewhat less than half the length of the dorsal side of the first endopodite joint. Endopodite (figs. 7 and 11): The shortest of the three ventral bristles on the first joint is only armed with short, fine hairs; of the two others one has from about seven to nine pairs of short secondary bristles proximally of the long ones, the other has either no such short bristles or only a few (one to four were observed). This joint is armed antero-distally with four short, powerful, pointed chitinous spines (from which the species derives its name); cf. fig. 10. Second joint: This has four rather short proximal bristles, subequal or only differing rather slightly in length; the longest of these is only about from a quarter to a sixth of the length of the main bristle a. Between the main bristles b and c there is a long, narrow bristle with short hairs. The medial cleaning bristles on this joint are very numerous, but vary. Four specimens that were investigated showed the following conditions:

Type specimen: Right mandible	7 bristles in a distinct lower row.
	8 ,, ,, ,, ,, upper ,,
	3 ,, ,, ,, ,, row inside the main bristle b.
	1 bristle above bristle no. 1 of the latter row.
	1 ,, between the main bristles a and b.
	1 ,, close to the main bristle a.

,, ,, Left ,,	8 bristles in a distinct lower row.
	7 ,, ,, ,, ,, upper ,,
	1 bristle above bristles nos. 3 and 4 of the latter row.
	1 ,, ,, ,, ,, 5 ,, 6 ,, ,, ,, ,,
	2 bristles inside the main bristle b.
	1 bristle between the main bristles a and b.
	1 ,, close to the main bristle a.

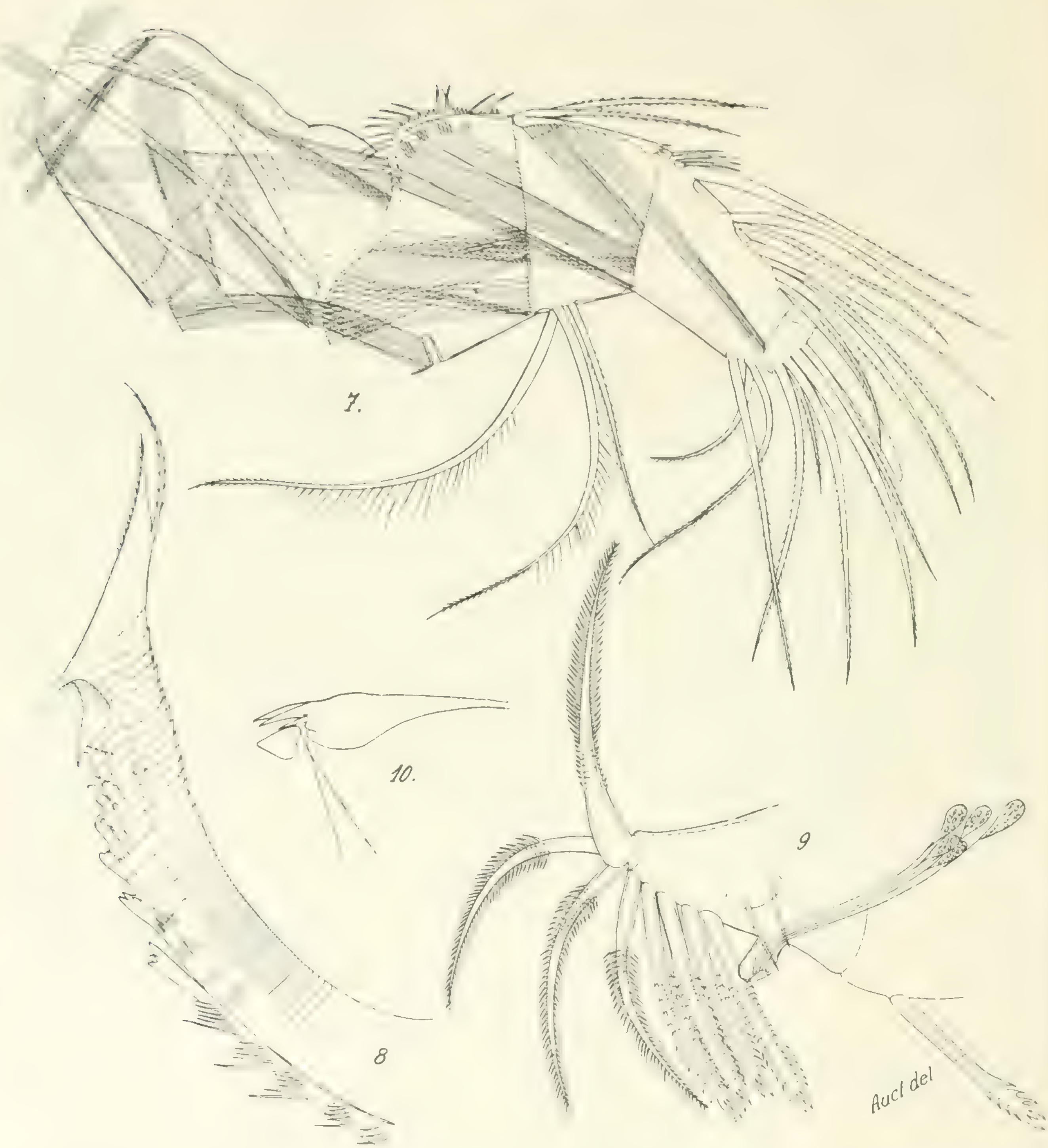

Fig. LXXXVII. — *Asterope spinifera* n. sp., ♀. — Mandible. 7. Left mandible, seen from inside; the cleaning bristles of the second endopodite joint are not drawn; the large lateral muscles of the first protopodite joint are only indicated by their outlines; 123 ×. 8. The endite of the coxale; 383 ×. 9. The backward pointing process of the basale; the glands are of course much more numerous; 325 ×. 10. Dorso-distal part of the first endopodite joint; 371 ×.

Specimen no. 2. Right mandible	7 bristles in a distinct lower row. 6 ,, ,, ,, ,, upper ,, 4 ,, not forming a distinct row, inside the main bristle b. 1 bristle between the main bristles a and b. 1 ,, close to the main bristle a.
,, ,, ,, Left ,,	7 bristles in a distinct lower row. 6 ,, ,, ,, ,, upper ,, 3 ,, ,, ,, ,, row inside the main bristle b. 1 bristle between the main bristles a and b. 2 bristles close to the main bristle a.
Specimen no. 3. Right ,,	8 bristles in a distinct lower row. 5 ,, ,, ,, ,, upper ,, 2 ,, inside the main bristle b. 1 bristle between the main bristles a and b. 2 bristles close to the main bristle a.
,, ,, ,, Left ,,	8 bristles in a distinct lower row. 7 ,, ,, ,, ,, upper ,, 1 bristle above bristle no. 5 of the latter row. 3 bristles in a row inside the main bristle b. 1 bristle between the main bristles a and b. 1 ,, inside the main bristle a.
,, ,, 4. Right ,,	6 bristles in a distinct lower row. 6 ,, ,, ,, ,, upper ,, 2 ,, inside the main bristle b. 1 bristle between the main bristles a and b. 2 bristles close to the main bristle a.
,, ,, ,, Left ,,	7 bristles in a distinct lower row. 1 bristle below bristle no. 3 of this row. 6 bristles in a distinct upper row. 1 bristle above bristle no. 3 of the latter row. 2 bristles inside the main bristle b. 1 bristle between the main bristles a and b. 1 ,, close to the main bristle a.

The end claw is powerful, about as long as the anterior side of the second endopodite joint to the fixing point of the main bristle d, smooth.

Maxilla (fig. 12): — Protopodite: The distal endite is armed with three subequal bristles. The dorso-proximal bristle is rather long. The basale has one ventral bristle

of about the same length as the dorso-proximal bristle. This joint has one rather short dorso-distal bristle and has the short ventero-distal bristle developed. E n d o p o d i t e: The postero-distal bristle of the first joint and the bristle of the end joint are subequal.

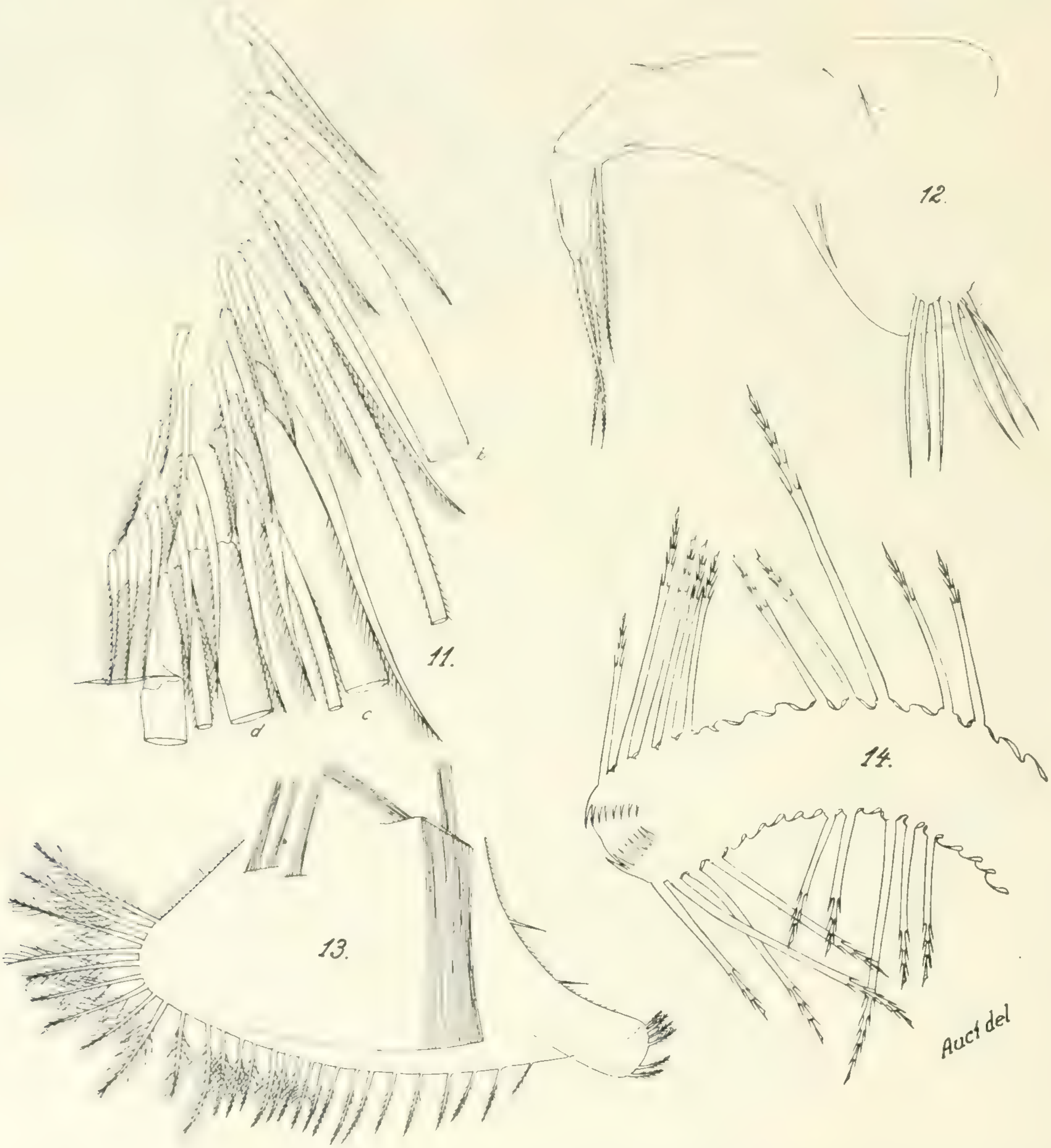

Fig. LXXXVIII. — *Asterope spinifera* n. sp., ♀. — 11. Anterior part of the second endopodite joint of the left mandible seen from inside; 464 ×. 12. Right maxilla seen from inside; 147 ×. 13. Right sixth limb seen from outside; 105 ×. 14. Seventh limb; 176 ×.

S i x t h l i m b (fig. 13): — The posterior edge is in most cases almost straight; the posterior ventral corner is, however, well rounded; 23—28 postero-ventral bristles, six antero-ventral bristles; the anterior edge has two bristles.

The s e v e n t h l i m b (fig. 14) is practically of quite the same type as in the preceding species. From seventeen to twenty cleaning bristles, from eight to ten on each side, were observed. On one specimen only two bells were found on one cleaning bristle. Each end comb consists of from sixteen to eighteen teeth.

F u r c a: — This has ten claws, of which the eight anterior ones may be denoted as main claws. The two anterior main claws have no basal teeth ventrally. The secondary claws are annulated.

The l a t e r a l e y e s are well developed. The m e d i a n e y e is smooth.

M a l e unknown.

Remark: — This species resembles very closely with regard to the shape of its shell *A. australis*, G. S. BRADY, 1890, p. 515, pl. IV, figs. 1 and 2, G. S. BRADY, 1898, p. 431, pl. XLIII, figs. 1—8 and TH. SCOTT, 1912a, p. 586, pl. XIII, figs. 18, 19. This species of BRADY's is certainly not a real unit, as is shown, among other things, by the length of the shell, 2,1 mm., BRADY, 1890, 1,4 mm., BRADY, 1898, 2,75 mm., SCOTT, 1912a. It is quite impossible to decide the relation of the species described by me above to the specimens on which these three accounts are based, on account of the deficiency of the descriptions given by the above writers.

Habitat: — S o u t h G e o r g i a: S. A. E., Station 34, off the mouth of Cumberland Bay, lat. 54° 11′ S., long. 36° 18′ W., (t y p e - l o c a l i t y); 5. VI. 1902; depth 252—310 m.; greyish clay with scattered stones; temperature at the bottom, + 1,45° C: 7 mature females and 1 male juvenis; R. M. S. 163.

T i e r r a d e l F u e g o: S. M. E., Straits of Magellan, Puerto Condor; 26. II. 1896; depth., 70 m.: one female larva; R. M. S., on slides.

Type-specimen on slides in the collections of R. M. S.

Asterope Mülleri* n. sp.

Cylindroleberis teres, G. W. MÜLLER, 1894, p. 220, pl. 4, figs. 13, 30, 43, pl. V, figs. 15, 24, 25, pl. VIII, fig. 5.

Description: — F e m a l e: —

S h e l l: — Length, 1,37—1,41 mm.; length : height about 1,42 : 1; length : breadth about 2 : 1. S e e n f r o m t h e s i d e (fig. 1) it is somewhat pear-shaped, with its greatest height just behind the middle and the back part strikingly larger than the front. The dorsal and ventral margins are almost of the same shape, moderately and uniformly curved, somewhat flattened anteriorly; they pass evenly into the anterior and posterior margins. The posterior parts of the dorsal and ventral margins form, together with the posterior margin, almost a semi-

* This species is called after Professor G. W. MÜLLER, our foremost investigator of the Ostracod group.

circle. The anterior margin too is evenly and boldly rounded. Seen from below (fig. 2) the shell is narrow and oviform, with its greatest breadth just behind the middle; the posterior end is somewhat more broadly rounded than the anterior end; the side contours are evenly curved. Seen from inside: Medial bristles: On the rostrum there are rather few or a moderate number of bristles, of which those that are situated nearest to the anterior margin of the shell show signs of being arranged in a sparse row running somewhat within and about parallel to the anterior margin of the shell; the rest are scattered. Most of these bristles are of moderate length, a number, especially amongst those situated farthest in, are more or less short. In the incisur there are similarly rather few or a moderate number of moderately long bristles, some of which are scattered on the anterior wall of the incisur, and some arranged in a close, distinct row running somewhat within and about parallel to the ventral margin of the rostrum. On the part just behind the incisur there are rather few or a moderate number of scattered bristles, of which those situated farthest in are more or less short, the others moderately long. Along the ventral margin of the shell to the spine-bearing list there is a single sparse row of rather short bristles. Almost parallel to and half way between the posterior margin of the shell and the spine-bearing list a distinct row of moderately long bristles runs; this row, which extends along the whole of the spine-bearing list, is rather close ventrally, but becomes more and more sparse dorsally, and the bristles become shorter at the same time (fig. 3). The spine-bearing list has 29—37 hyaline spines varying somewhat in size. There are usually no bristles between the ventrally situated of these spines; there is usually one short bristle between each of the others, but sometimes there is no bristle even between these latter spines. There are no broad pores at all between the list and the posterior margin of the shell.

First antenna (fig. 4): — This has seven joints, but the third and fourth joints are rather slightly separated from each other, especially on the lateral side of the limb. These two joints together form a joint considerably shorter than it is high and somewhat shorter than the total length of the fifth and sixth joints. The distal boundary of the fourth joint is rather decidedly concave. The anterior bristle of the second joint is somewhat longer than the anterior side of this joint. The third joint has six anterior bristles, of which nos. 5 and 6 are situated at the side of each other. Of these bristles nos. 1, 2 and 4 are armed ventrally with long, stiff secondary bristles; bristles nos. 3 and 6 also have long secondary bristles, but these are considerably fewer and perhaps somewhat shorter and weaker than those on the three former bristles; bristle no. 5 has short hairs. The longer of the two postero-distal bristles on the fourth joint was somewhat shorter on the type specimen than on the Naples specimen and about as long as the total length of the fifth to the sixth joints. The stem of the sensorial bristle of the fifth joint is about as long as the total length of the third to the fifth joints; it has six sensorial filaments. The end joint has six bristles; the d-bristle is represented only by a verruciform process. The a-claw, which is very weakly pectinated dorsally, is somewhat longer than the total length of the anterior sides of the two next to the distal joints. The f-bristle has four sensorial filaments; the e- and g-bristles have five distal filaments. Pilosity: The first joint has short hairs, though only sparsely, dorsally, especially on the outside, and ventrally, especially on the inside. The second

joint is very sparsely furnished with short hairs both on the anterior and the posterior sides; along the distal boundary of the last-mentioned joint there is on the outside a series of short, stiff hairs, often somewhat longer than the other hairs.

Second antenna: — Distally on the inside close to the exopodite the protopodite has a very short bristle. The exopodite has four bristles on the end joint. The fourth to the ninth joints (on the Naples specimen the third to the ninth joints) of this branch have basal spines, which decrease in size and strength the more proximally they are situated, the one on the fourth joint being scarcely perceptible. The endopodite (fig. 5) is small with scarcely distinguishable joints; its end bristle is about twice the length of the stem.

Mandible: — Protopodite: — Coxale: The scythe-shaped process (fig. 7): The part situated distally of the main spine grows uniformly and gently narrower into a fine point; its ventral edge is even and somewhat convex. The distance from the point of the process to the main spine is about as great as the distance from the latter to the proximal ventral spine. The dorsal bristle is attached somewhat nearer the point of the process than its distance from the main spine and is situated somewhat more than half its length distally of the latter; it extends to a distance of not quite half its length beyond the distal point of the process. The dorsal serrate teeth are exceedingly small; they seem sometimes practically even to be absent; they are not indicated in the figure. The main spine is rather small. There are four or five ventral spines, the proximal one of which is rather strong, the rest are very weakly developed. On the part situated distally of the main spine there are about eight or nine transverse rows of hairs. The rod-shaped process is blunt distally and is there furnished with three short, fine, bristle-like points. Basale: The backwards pointing process has three or four distal bristles, four triaena bristles and one dwarf bristle. The triaena bristles have from one to six pairs of secondary spines under the distal pair of spines. The peg on which the glands emerge is rather small. The dorsal side of this joint is quite smooth, without either hairs or bristles. The exopodite (fig. 6) is, if we include its two distal bristles, about as long as or slightly longer or shorter than the anterior side of the first endopodite joint. Endopodite (fig. 6): Of the three ventral bristles on the first joint the shortest one has short hairs, the two others have, proximally of the long secondary bristles, respectively about six to nine and ten to sixteen pairs of short secondary bristles. Antero-distally this joint is not armed with chitinous spines. Second joint: This has only one proximal bristle, which is about a fifth of the length of the main bristle a. Between the main bristles b and c there is a long, narrow bristle with short hairs. The medial cleaning bristles are relatively few: the specimen from the coast of England that I was able to investigate showed the following arrangement of these bristles:

Right mandible	5 bristles	in a distinct lower row.
	2 ,,	below the main bristle b.
Left mandible	6 bristles	in a distinct lower row.
	2 ,,	below the main bristle b.

The Naples specimen showed the following arrangement:

Right mandible	5 bristles in a distinct lower row.
	2 ,, ,, ,, ,, upper ,,
	1 bristle close to the main bristle b.
Left mandible	5 bristles in a distinct lower row.
	3 ,, ,, ,, ,, upper ,,

The end claw is unusually powerful, about as long as the anterior sides of the two distal joints; it is very weakly pectinated.

M a x i l l a (fig. 8): — P r o t o p o d i t e: The distal endite has three bristles, the middle one of which is somewhat shorter than the two others. The dorso-proximal bristle is very short. The basale has one moderately long ventral bristle; the short ventero-distal bristle is developed and one dorso-distal bristle of moderate length. E n d o p o d i t e: The postero-distal bristle of the first joint is only about half the length of the bristle on the end joint.

S i x t h l i m b: — The posterior edge is fairly straight; the posterior ventral corner, however, is rather broadly rounded (about the same as in fig. 7 of *A. Mülleri* var. *longiseta*). It has about sixteen posterior and two anterior ventral bristles. Two bristles are developed on the anterior edge.

S e v e n t h l i m b: — This is armed with twelve cleaning bristles of moderate and somewhat different lengths. Of these bristles six are situated close together distally, three on each side, six are scattered somewhat proximally of the former, three on each side of the limb (about the same as in fig. 10 of *A. Ohlini*). Each cleaning bristle has three or four bells. Each end comb consists of about ten to twelve teeth, which increase somewhat in strength the nearer to the point of the limb they are situated. The two or three proximal teeth on both sides of the end comb are armed with from about four to six pairs of rather fine secondary spines (about the same as in fig. 8 of *A. Mülleri* var. *longiseta*). The distal teeth are armed with one or sometimes two pairs of very powerful secondary spines. The points of the teeth are very powerful, lancet-like, finely serrated (about the same as in fig. 8 of *A. Mülleri* var. *longiseta*).

F u r c a: — This has nine claws, of which the six anterior ones may be denoted as main claws. The two anterior main claws have no basal ventral teeth. The three secondary claws are more or less distinctly annulated.

The l a t e r a l e y e s are well developed. The m e d i a n e y e has short, fine hairs (indicated in the accompanying figure 9).

The m a l e is unknown.

[illegible]

Remarks: — The description given above is based chiefly on one specimen, a mature female that was kindly sent to me by Professor G. S. BRADY and that was determined by this investigator as *Asterope teres* (A. M. NORMAN).

This species of A. M. NORMAN's was introduced into the literature, 1861, p. 280 under the name of *Cypridina teres*. The original description, which is based on the investigation of an empty shell, — „animal incognitum" — is very incomplete; only the following information

is given: „Shell ovate, not produced, very slightly widening just below the middle, quite smooth, pure white, moderately and regularly convex. Oral slit narrow and somewhat semicircular

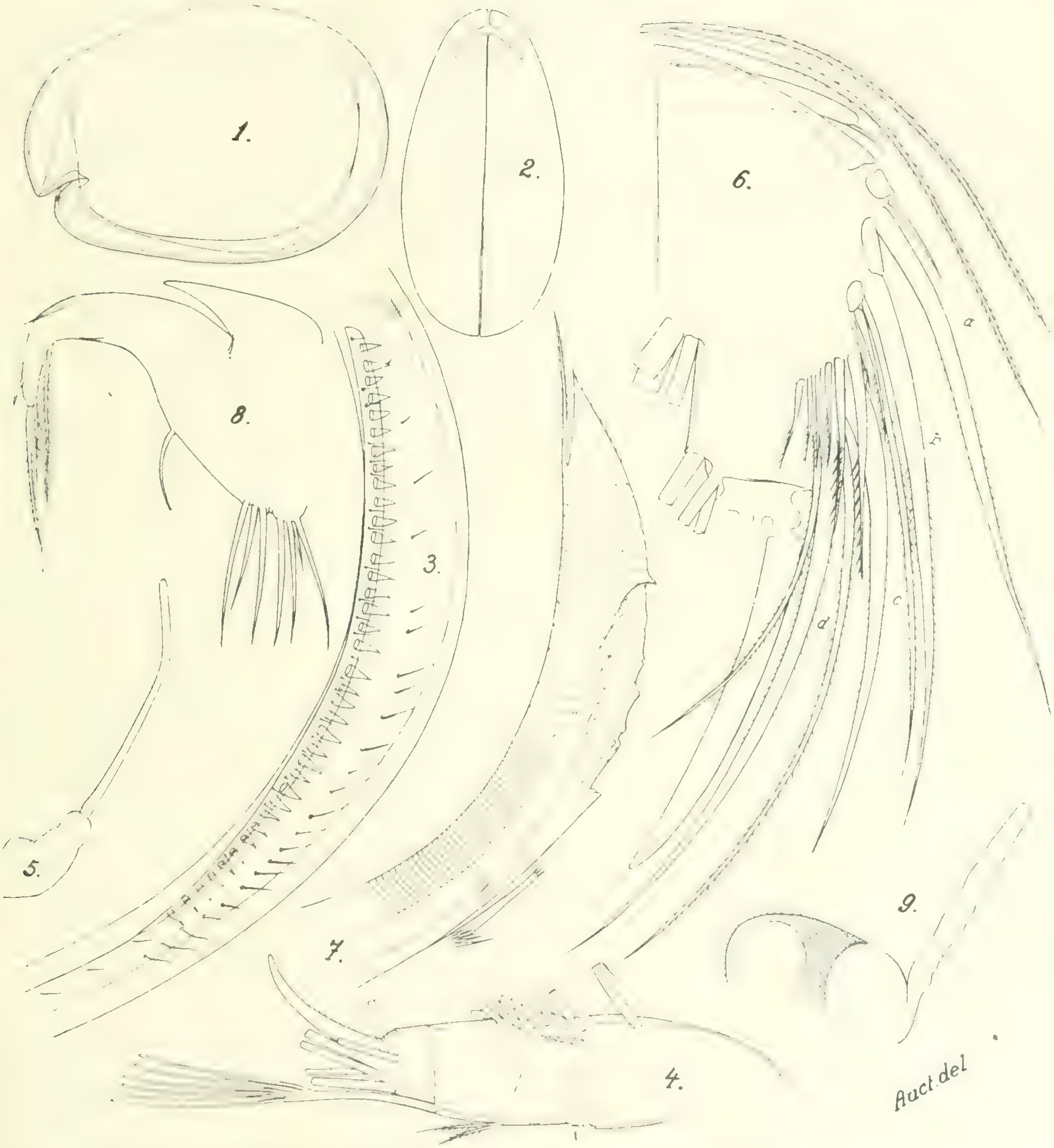

Fig. LXXXIX. — *Asterope Mülleri* n. sp., . — 1. Shell seen from the side; 52 ×. 2. Shell seen from below; 38 ×. 3. Posterior part of the right valve seen from inside; 160 ×. 4. Right first antenna seen from inside; most of the bristles are broken; 160 ×. 5. Endopodite of the second antenna; 320 ×. 6. Endopodite of the left mandible seen from inside; the posterior bristles are broken; 392 ×. 7. The endite of the coxale of this limb; 560 ×. 8. Right maxilla seen from inside; 172 ×. 9. Rod-shaped organ and median eye; 240 ×.

ar form. Length 1/15 inch (= 1.7 mm.)". Only one figure, that of the shell seen from the side, accompanies this general and incomplete description, from which it is only clear that a form belonging to the family *Asteropidae* was before the writer. This figure shows an oviform shell with its greatest height somewhat behind the middle and the posterior part of the shell comparatively slightly larger than the anterior part; the proportion of the length to the height is 1.54 : 1; the dorsal and ventral margins are evenly curved, the former distinctly more boldly than the latter.

These facts obtained from the original description and figure seem to show with all desirable clearness that Professor G. S. BRADY's identification of the specimen on which the species I have described is based as *A. teres* (A. M. NORMAN) cannot be considered as having sufficient proof to support it.

Although this species of A. M. NORMAN's is based only on an incomplete investigation of an empty shell, subsequent writers have nevertheless succeeded in identifying with it not only forms that they have investigated themselves, but also forms incompletely described by other authors and obviously not re-examined by themselves. Thus G. S. BRADY and A. M. NORMAN in their work of 1896 include this species and give the following forms as synonyms of it: *Cylindroleberis teres*, G. S. BRADY, 1867 and 1868 a and b, ? *Asterope oblonga*, C. CLAUS, 1876 and *Cylindroleberis teres*, G. W. MÜLLER, 1894. — G. W. MÜLLER also includes this species of NORMAN's in „D a s T i e r r e i c h"; as synonyms of it are given: ? *Bradycinetus teres*, A. M. NORMAN, 1867, *Asterope oblonga* and *A. ovalis*, C. CLAUS, 1876, *Copechaete armoricana* + *C. fissa*, E. HESSE, 1878, *Cylindroleberis teres*, G. W. MÜLLER, 1894 and ? *Asterope oculata*, G. S. BRADY, 1902 a. —

As far as one can see these investigators have followed the principle of combining into one species all forms of the genus *Asterope* which are characterized by having the posterior part of the shell dominating more or less strongly over the anterior part. It seems certain that this method of procedure can scarcely be considered justifiable and that it can only be explained as due to these writers' deficiency of knowledge of these forms. A study of the species of this genus that are dealt with in this treatise will show this quite clearly. Compare, for instance, *A. Mülleri* var. *longiseta*, *A. Ohlini* and *A. curta* with the species dealt with above. These species clearly show that forms quite obviously distinct from one another with regard to the limbs, etc. may, all the same, show a striking resemblance with regard to the shape of the shell; i. e. that in this range of forms the shape of the shell alone cannot be considered sufficient to characterize a species.

It seems best, in order to avoid further confusion, to delete *A. teres* altogether from the list of identifiable species, at least for the present. Only if a careful study of the Ostrocod fauna at the type-locality, Oban, Firth of Lorne, Scotland, were to prove that only a single species is found here with about the same type of shell as these forms would it be proper, to adopt this species name of NORMAN's again.

The form described by G. S. BRADY 1868 b, p. 465, under the name of *Cylindroleberis teres* (NORMAN) shows a very striking resemblance to the species described by me above with regard to the shape of its shell. — On the other hand the resemblance to the species of

A. M. NORMAN's discussed above is consequently far from striking. — Nor do the description and the figures of the limbs, pl. 41, figs. 2 a—d, form any direct argument — if we leave out of account obvious mistakes in observation and drawing — against this form of G. S. BRADY's being possibly identical with the species described by me above. All the same I have not carried out this synonymization, as is seen above, as it would in any case be so uncertain as to have practically no scientific value.

C. CLAUS, 1876, p. 93, writes that this form described by BRADY, is „wahrscheinlich" identical with a species found by him at Trieste, which he also identifies with E. GRUBE's *Cypridina oblonga**. Both G. W. MÜLLER and G. S. BRADY and A. M. NORMAN justly rejected the latter identification without further discussion, but these writers seem to hesitate a little more about the correctness of the former identification. It will be seen above that the two later writers, 1896, add a query to this synonymization and so does G. W. MÜLLER as well, 1894, p. 220; this was, however, deleted by G. W. MÜLLER in 1912, as is seen above. CLAUS does not give in the text any information about the shell of the species dealt with by him, but adds a figure of the shell as seen from the side. This figure shows an oviform shell with its greatest height just behind the middle; the proportion of the length to the height is 1,55 : 1; the posterior part of the shell dominates very slightly over the anterior one; the dorsal and ventral margins are evenly and almost symmetrically curved. The limbs are reproduced and described, but in such general terms that it is impossible to identify the species with certainty. It seems to follow from this that this form cannot very well be adopted as a synonym of the species described by me above. Nor can it be identified with any other of the forms dealt with here without disregarding the facts.

As is seen above, I have identified the species described by me above with G. W. MÜLLER's species *Cylindroleberis teres*, 1894. This identification is not based on G. W. MÜLLER's description and figures. It is based instead on an investigation I made of a specimen from the Bay of Naples, which Prof. G. W. MÜLLER had determined as *Cylindroleberis teres* and which was kindly placed at my disposal by this investigator. On the contrary G. W. MÜLLER's description and figures show not a few differences from the type-specimen described by me above. According to this the Bay of Naples form is distinguished by a shell only 1,24 mm. long; the shape of its shell, to judge from pl. 8, fig. 5, differs from the form described above, though only in details; the spine-bearing list has only 25 hyaline spines. First antenna: The boundary between the fourth and the fifth joints is not slightly concave, but forms a sharp, almost a right, angle. Maxilla: This has a strongly reduced epipodite; without any dorso-proximal bristle and without the short ventero-distal bristle on the basale; the proximal endite has no short bristle; the baleen bristles are blunt distally. — In all these characters the specimen from the Bay of Naples investigated by me closely agreed to the species described above. Its shell was 1,41 mm. long** and with regard to the shape of the shell it showed complete

* CLAUS writes, p. 93 [illegible] n. 5 *Asterope ovalis* in the description of the form found by him, but this seems, as far as one can judge, to be a slip of the pen.

** It will be seen that I have not adopted G. W. MÜLLER's statement of the length, 1,24 mm. in my description of the species, as it does not seem impossible that this is incorrect, that there has been a printer's error, a reversal of the two last figures.

agreement with the figures given in this treatise; the bristle-bearing list had 29—31 spines. First antenna: The boundary between the fourth and fifth joints was like that shown in the figure given by me. Similarly the maxilla agreed entirely with that of the species described above. The difference I observed between the specimen from the Bay of Naples that I investigated and the type-specimen of this species with regard to the hyaline spines on the spine-bearing list, the postero-distal bristles on the fourth joint of the first antenna, the basal spines on the exopodite of the second antenna and the medial cleaning bristles of the mandible (see above) cannot be considered to stand in the way of this identification, as these are characters which, as I showed in the description of the genus, I did not find quite constant in the species of this genus. With regard to the postero-distal bristles on the fourth joint of the first antenna G. W. MÜLLER's fig. 30, pl. 4 agrees well with mine, a fact which may, of course, be considered to support this identification still further.

G. S. BRADY's and A. M. NORMAN's species *Asterope teres*, 1896, differs strikingly with regard to the shape of its shell both from the former author's *Cylindroleberis teres*, 1868 b, and from the species of G. W. MÜLLER's discussed above. Nor does the latter author synonymize these forms with each other, 1912. Consequently this form cannot well be synonymized with the species described by me above either. G. S. BRADY's and A. M. NORMAN's description and figures are of such a nature with regard to characters other than the shape of the shell that all that can be said — due consideration being paid to probable and certain errors in observation and drawing on the part of these authors — is that this form is presumably comparatively closely related both to BRADY's species, 1868 b, and to the form described by me above.

With regard to G. W. MÜLLER's synonymization of *Copechaete armoricana* and *C. fissa* with forms that come into this genus see the historical summary of this family, p. 434 above. For his synonymization, 1912, of *Asterope oculata* G. S. BRADY see the remarks under this species in this treatise.

On account of the absence of descriptions and figures nothing certain can be said about the relation of the following forms to the species described by me above: *Bradycinetus teres*, A. M. NORMAN, 1867, p. 198, *Cypridina teres*, G. S. BRADY, 1867, p. 208, *Cylindroleberis teres*, G. S. BRADY, 1868 a, p. 128, *Asterope teres*, G. S. BRADY and D. ROBERTSON, 1872, pp. 54, 70, *A. teres*, G. S. BRADY and D. ROBERTSON, 1874, p. 115, *A. teres*, G. S. BRADY and D. ROBERTSON, 1876, p. 187, *A. teres*, A. M. NORMAN and G. S. BRADY, 1909, p. 359 and *Cylindroleberis teres*, O. de BUEN, 1916, p. 365.

In connection with this question of nomenclature I wish to point out here, though only in passing and as a curious fact, G. O. SARS's assumption that *Asterope teres* is the female of *A. Mariae* (W. BAIRD). This assumption was put forward in his work of 1869, p. 357, obviously under the influence of his discovery of the dimorphism in the genus *Philomedes* (G. O. SARS 1869, p. 355). At first G. S. BRADY hesitated about this assumption, 1871, p. 295, but then he adopted it altogether (G. S. BRADY, H. W. CROSSKEY and D. ROBERTSON, 1874, p. 218); in his later works he passed it over quite in silence. Other authors do not even trouble to discuss it. G. O. SARS maintains it, however, even in his latest work on these forms, 1887, p. 13.

Habitat: — Coast of England: Salcombe, English Channel (type-locality): one mature female and one larva (coll. G. S. BRADY); R. M. S., on slides. Mediterranean Sea: Naples: one mature female (coll. G. W. MÜLLER); on slides, R. M. S.

Asterope Mülleri n. sp. var. longiseta n. var.

Description: — Female: —

Shell: — Length, 1,62—1,66 mm.; length : height about 1,4 : 1, lenght : breadth about 1,9 : 1. Seen both from the side and from below (figs. 1 and 2) it is of quite the same type as the shell of *A. Mülleri.* Seen from within: Medial bristles: These also show a great resemblance to those of the type species; it is to be noted, however, that the rather few bristles in the incisur are scattered and the row of bristles between the spine-bearing list and the posterior margin of the shell is either only developed along the ventral half of the spine-bearing list or else — and this seems to be the most common case — it is represented dorsally by single bristles (cf. fig. 3). The spine-bearing list has about 31—32 hyaline spines which vary somewhat in size; its bristles are like those of *A. Mülleri*; two bristles were very seldom found between a pair of hyaline spines. As in *A. Mülleri* there are no broad pores between the list and the posterior margin of the shell.

First antenna: — This is very like this limb in *A. Mülleri.* It is to be noted: The third and fourth joints form together an almost quadratic joint, only rather slightly shorter than it is high and somewhat shorter than the total length of the fifth and sixth joints. The distal boundary of the fourth joint is moderately concave. The longer of the two postero-distal bristles on the fourth joint is shorter than the total length of the fifth and sixth joints. The c-bristle has five, the f-bristle has four or five and the g-bristle five or six sensorial filaments.

Second antenna: — Distally on the inside close to the exopodite the protopodite has a very short bristle. The end joint of the exopodite has four bristles. The fourth to the ninth, sometimes the third to the ninth, joints of this branch have basal spines. The endopodite (fig. 4) is very small, almost quite unjointed; its distal bristle is more than twice, sometimes as much as three times, as long as the stem.

Mandible: — This is very like the corresponding limb in *A. Mülleri.* We must note: Protopodite: Coxale: The scythe-shaped process (fig. 5) has six ventral spines, all with double points, the distal ones rather weak. Sometimes, when the fine points are worn off on the four distal spines, the latter are only represented by weak, rounded swellings as in *A. Mülleri.* Basale: The backward pointing process has four distal bristles, four triaena bristles and one dwarf bristle. On the triaena bristles from three to five pairs of spines were observed under the distal pair of spines. The glands of this process emerge on a peg which is almost as large as in fig. 9 of *A. spinifera.* The dorsal side of this joint is either smooth or is furnished with a few groups of short, fine, stiff hairs. Endopodite: The second joint has one proximal bristle, which is about a third of the length of the main bristle a. The medial

cleaning bristles are fairly constant: six bristles in a distinct lower row and two or three bristles close to the main bristle b were observed, they are sometimes different even on the right and left mandibles of the same individual.

M a x i l l a (fig. 6): — P r o t o p o d i t e: The distal endite is armed with three bristles, which are either subequal or else the middle one is somewhat shorter than the other two. The dorso-proximal bristle is moderately long, in most cases somewhat longer than the ventral bristle on the basale. The basale has the short ventero-distal bristle developed and a single unusually long dorso-distal bristle (it is practically the same length as the bristle of the end joint), a character

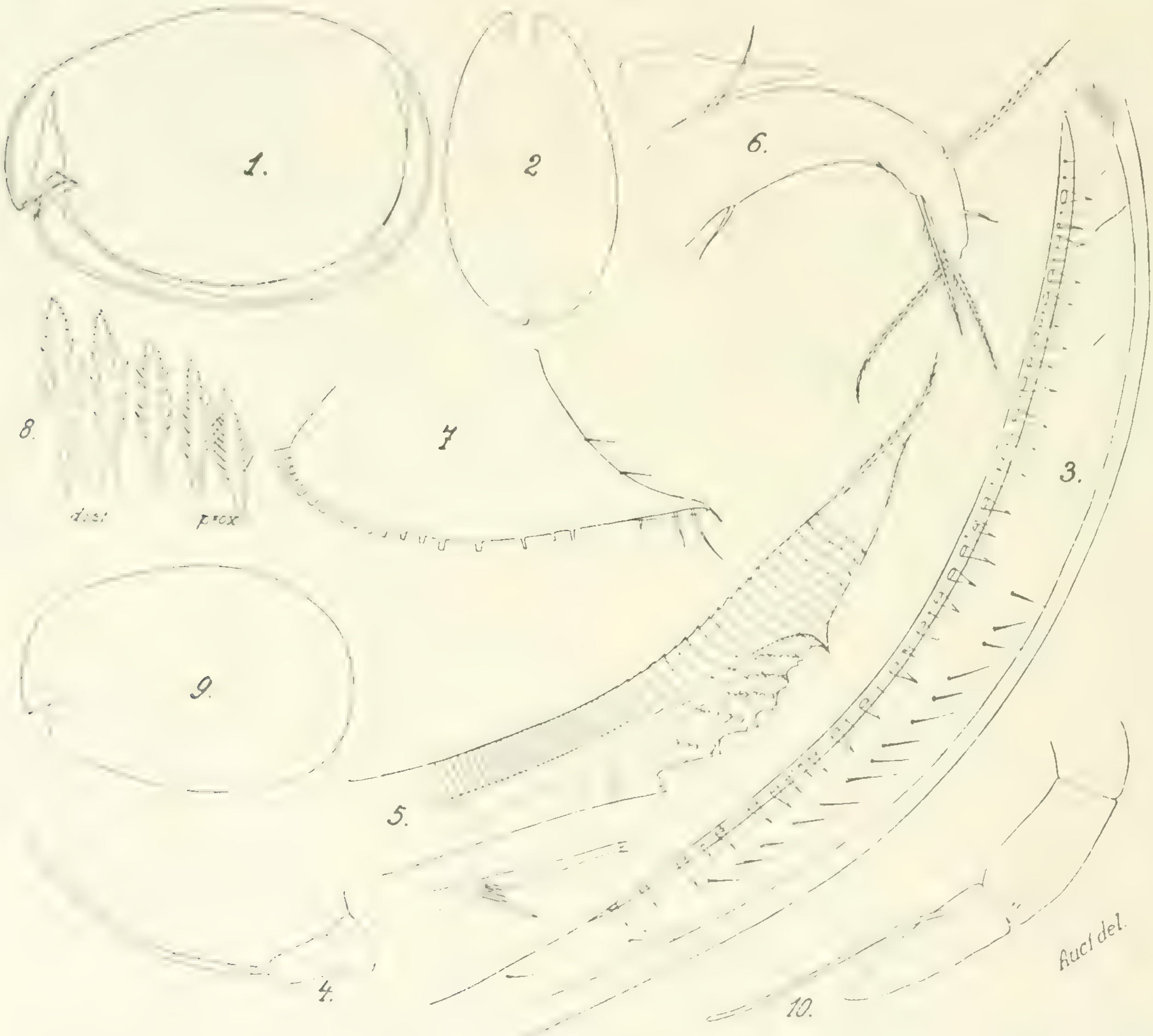

Fig. XC. — *Asterope Mülleri* var. *longiseta* n. sp. et. var. — 1. Shell seen from the side, ♀; 38 ×. 2. Shell seen from below, ♀; 27 ×. 3. Posterior part of the right valve seen from inside, ♀; 172 ×. 4. Endopodite of the second antenna, ♀; 212 ×. 5. Endite on the coxale of the mandible, ♀; 480 ×. 6. Left maxilla, seen from inside, ♀; 160 ×. 7. Sixth limb; the posterior ventral bristles are broken, ♀; 120 ×. 8. A part of an end comb of the seventh limb, ♀; 1120 ×. 9. Shell seen from the side, ♂, Stage I; 32 ×. 10. Endopodite of the second antenna of this larva; 224 ×.

from which the species has its name. Endopodite: The posterior distal bristle of the first joint is somewhat shorter than the bristle of the end joint.

Sixth limb (fig. 7): — The back edge is fairly straight, the postero-ventral corner is, however, broadly rounded. It has 19—21 posterior and three or four anterior ventral bristles. Two bristles are developed on the anterior edge of the limb.

Seventh limb: — This is of the same type as in *A. Mülleri.* The distal teeth in the end combs are most frequently armed with from one to three pairs of very powerful secondary teeth; cf. fig. 8.

The furca, lateral eyes and median eye are about the same as in *A. Mülleri.*

The male is unknown.

Habitat: — Falkland Islands: S. A. E., Station 51, Port William (type-locality); 3. IX. 1902; depth, 22 m.; sand: 4 mature females and 4 larvae; R. M. S. 165 and 166. S. A. E., Station 53, Port William; 3. IX. 1902; depth, 12 m.; sand and gravel: 2 larvae; R. M. S. 167. S. A. E., Station 55, Port Albemarle, lat. 52° 11′ S., long. 60° 26′ W.; 8. IX. 1902; depth 40 m.; sand and algae: one mature female; R. M. S., on slides.

Type-specimen on slides in the collections of the R. M. S.

Asterope Ohlini n. sp.

Description: — Female:

Shell: — Length, 2,0—2,2 mm.; length : height about 1,4 : 1; length : breadth about 1,95 : 1. As is seen from the accompanying figures 1 and 2 it has practically quite the same type as the shell of *A. Mülleri,* both when viewed from the side and from beneath. The posterior part of the shell, seen from the side, is sometimes a little less rounded than in the species mentioned and more sharply cut off than in the accompanying figure. Seen from inside: The medial bristles are also almost similar to those in the species mentioned. The row of bristles between the spine-bearing list and the posterior margin of the shell is, however, rather irregular, often even more irregular than in the accompanying figure 3. The spine-bearing list is provided with about 43—52 hyaline spines varying somewhat in size. There are usually no bristles at all between the most ventrally situated of these spines; between each of the others there are usually one or two, sometimes even three, short bristles varying somewhat in length. Between the spine-bearing list and the posterior margin of the shell there are no broad pores such as are found in *A. spinifera.*

First antenna (fig. 4): — This is very like this limb in *A. Mülleri.* There are, however, some differences to be noted: The third and fourth joints together form an almost quadratic joint, about as long as or rather slightly shorter than the total length of the fifth and sixth joints. The distal boundary of the fourth joint is moderately concave. The longest posterior distal bristle of the fourth joint is shorter than the total length of the fifth and sixth

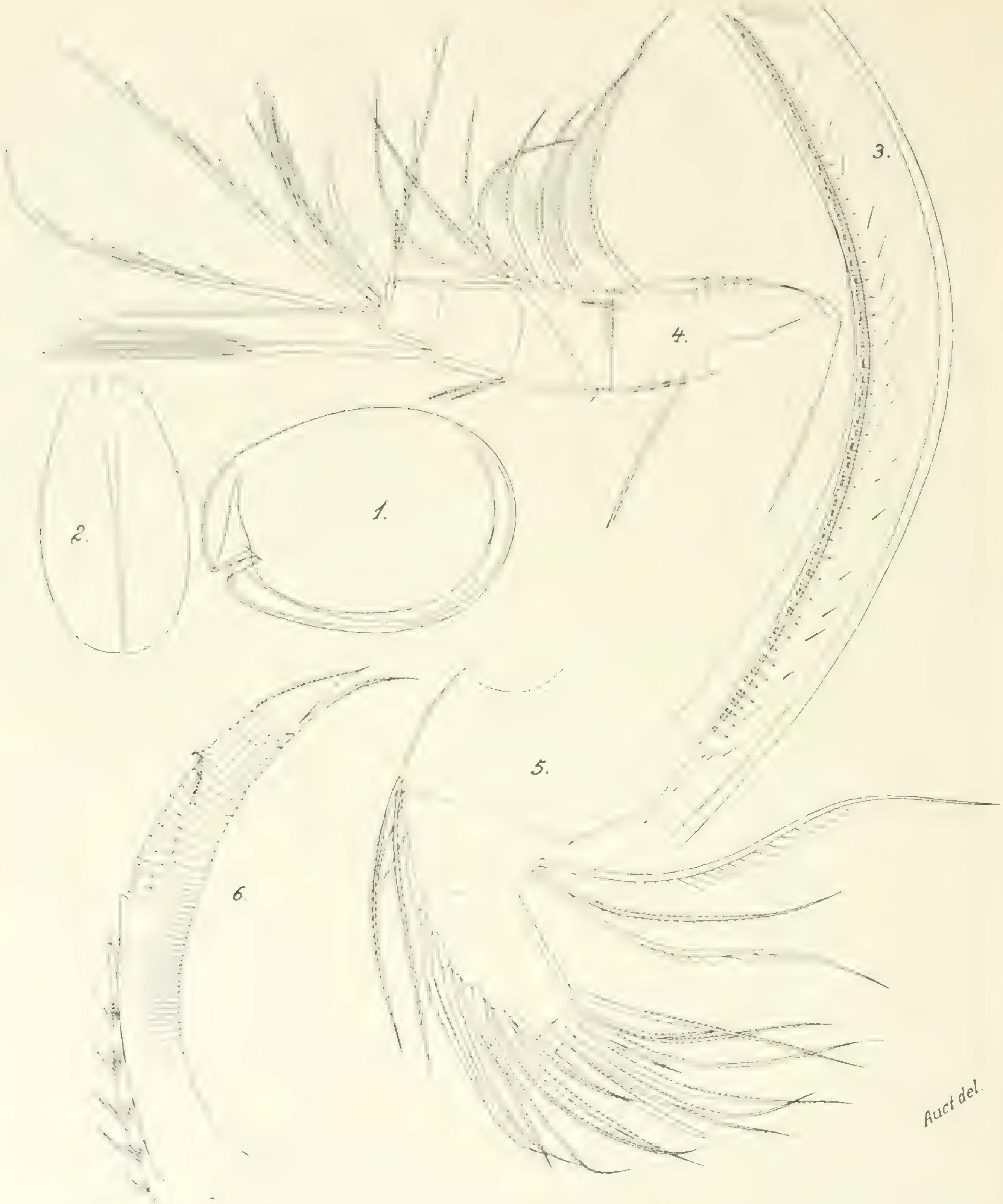

Fig. XCI. — *Asterope Ohlini* n. sp., ♀. — 1. Shell seen from the side; 26 ×. 2. Shell seen from below; 24 ×. 3. Posterior part of the right valve seen from inside; 120 ×. 4. Left first antenna seen from outside; 128 ×. 5. Right mandible seen from inside; the cleaning bristles of the second endopodite joint are not drawn; 140 ×. 6. Endite of the coxale of this limb; 356 ×.

joints. The a-claw is smooth. The c-bristle has four or five, usually five filaments, the f-bristle has four or five filaments and the g-bristle has six filaments.

Second antenna: — This is like that of *A. Mülleri.* The fourth to the ninth joints on the exopodite have basal spines. The endopodite is rather distinctly threejointed; its end bristle is about as long as or slightly longer than the stem.

Mandible: — Protopodite: Coxale: The scythe-shaped process (fig. 6) is very like this process in *A. Mülleri.* It is to be noted: The dorsal serrate teeth, although very small, are perhaps slightly more strongly developed than in the species mentioned. Basale: The backward pointing process has four distal bristles, four or five triaena bristles and, as in the preceding species, only one dwarf bristle. On the triaena bristles were observed from two to five pairs of spines below the distal pair. The glands emerge on a rather well developed peg, but this is not so large as in fig. 9 of *A. spinifera.* The dorsal side of this joint is quite smooth, without either hairs or bristles. The exopodite (fig. 5) is rather powerful; if its end bristles are included, it is about as long as or slightly more than three-quarters of the length of the anterior side of the first endopodite joint. Endopodite (figs. 5 and 7): The shortest one of the three ventral bristles of the first joint has short hairs; the two others have a few pairs of short secondary bristles proximally of the long secondary bristles. This joint is not armed with any chitinous spines antero-distally. The second joint has only one proximal bristle, which is somewhat less than a third of the length of the main bristle a. Between the main bristles b and c there is a long, narrow bristle with short hairs. The medial cleaning bristles vary to some extent; they are rather numerous and are arranged in two rows; six specimens that were investigated showed the following conditions:

Type specimen: Right and left mandible	7 bristles in a distinct lower row. 5 ,, ,, ,, ,, upper ,, 2 ,, inside the main bristle b.
Specimen no. 2. Right and left mandible	As in the type specimen; the lower row was, however, less distinct, its inner bristles were somewhat dislocated.
Specimen no. 3. Right mandible	7 bristles in a distinct lower row. 8 ,, ,, ,, ,, upper ,, 1 bristle close to the main bristle b.
,, ,, ,, Left ,,	7 bristles in a distinct lower row. 6 ,, ,, ,, ,, upper ,, 2 ,, inside the main bristle b.
,, ,, 4. Right ,,	7 ,, in a distinct lower row. 6 ,, ,, ,, ,, upper ,, 3 ,, ,, ,, ,, row inside the main bristle b.
,, ,, ,, Left ,,	7 ,, ,, ,, ,, lower row. 6 ,, ,, ,, ,, upper ,, 2 ,, above bristles nos. 1 and 3 of the latter row.

Specimen no. 5. Right mandible	7 bristles in a distinct lower row.
	5 ,, ,, ,, ,, upper ,,
	1 bristle above bristle no. 5 of the latter row.
	2 bristles close to the main bristle b.
	1 bristle between the main bristles a and b.
,, ,, ,, Left ,,	7 bristles in a distinct lower row.
	6 ,, ,, ,, ,, upper ,,
	3 ,, inside the main bristle b.
	1 bristle between the main bristle a and b.
,, ,, 6. Right ,,	7 bristles in a distinct lower row.
	7 ,, ,, ,, ,, upper ,,
	1 bristle above bristle no. 3 of the latter row.
	1 ,, close to the main bristle b.
,, ,, ,, Left ,,	7 bristles in a distinct lower row.
	6 ,, ,, ,, ,, upper ,,
	2 ,, inside the main bristle b.

The end claw very powerful, about as long as the anterior side of the second endopodite joint, finely pectinated.

M a x i l l a (fig. 8): — P r o t o p o d i t e: The distal endite is armed with three bristles, the middle one of which is somewhat shorter than the other two. The dorso-proximal bristle is moderately long. The basale has one ventral bristle, of about the same length as the dor o-proximal bristle and with the short ventero-distal bristle developed. In addition this joint has one relatively long dorso-distal bristle, of about the same length as the postero-distal bristle of the first endopodite joint. E n d o p o d i t e: The postero-distal bristle of the first joint is somewhat shorter than the bristle of the end joint.

S i x t h l i m b (fig. 9): — The posterior edge is straight or sometimes even weakly concave; the posterior ventral corner is unusually sharply defined, but is rounded. This limb has 21—24 posterior and two anterior ventral bristles. Two bristles are developed on the anterior edge.

S e v e n t h l i m b (fig. 10): — This is very like this appendage in the preceding species; on one specimen thirteen cleaning bristles were observed on the limb of one side. Each end comb has 12—14 teeth. The teeth have a somewhat varying number of secondary teeth, sometimes as in fig. 8 of *A. Mülleri* var. *longiseta*, sometimes as described for the type species of this form.

F u r c a: — This has nine claws; only in one specimen were ten claws observed on one lamella. The six or seven anterior of these claws may be called main claws. The two anterior main claws have no basal ventral teeth. The secondary claws are more or less distinctly annulated.

The l a t e r a l e y e s and the m e d i a n e y e are about the same as those of the preceding species.

The m a l e is unknown.

Habitat: — South Georgia: S. A. E., Station 22, off May Bay, lat. 54° 17′ S., long. 36° 28′ W.; 14. V. 1902; depth, 75 m.; clay with scattered algae; temperature at the bottom + 1,5° C.: 2 mature females; R. M. S. 168. S. A. E., Station 25, off Grytviken, lat. 54° 22′ S., long. 36° 27′ W.; 21. V. 1902; depth, 24—52 m.; grey clay with scattered algae: one mature female; R. M. S., on slides. S. A. E., Station 33, Grytviken, lat. 54° 22′ S., long. 36° 28′ W.; 30. V. 1902; depth 22 m.; clay with algae: 20 mature females and 7 larvae in different stages; R. M. S. 169. S. A. E., Station 34, off the mouth of Cumberland Bay, lat. 54° 11′ S., long. 36° 18′ W., (type-locality); 5. VI. 1902; depth, 252—310 m.; grey clay with scattered stones; temperature at the bottom, + 1,45° C.: 6 mature females; R. M. S. 170.

Type-specimen on slides in the collections of the R. M. S.

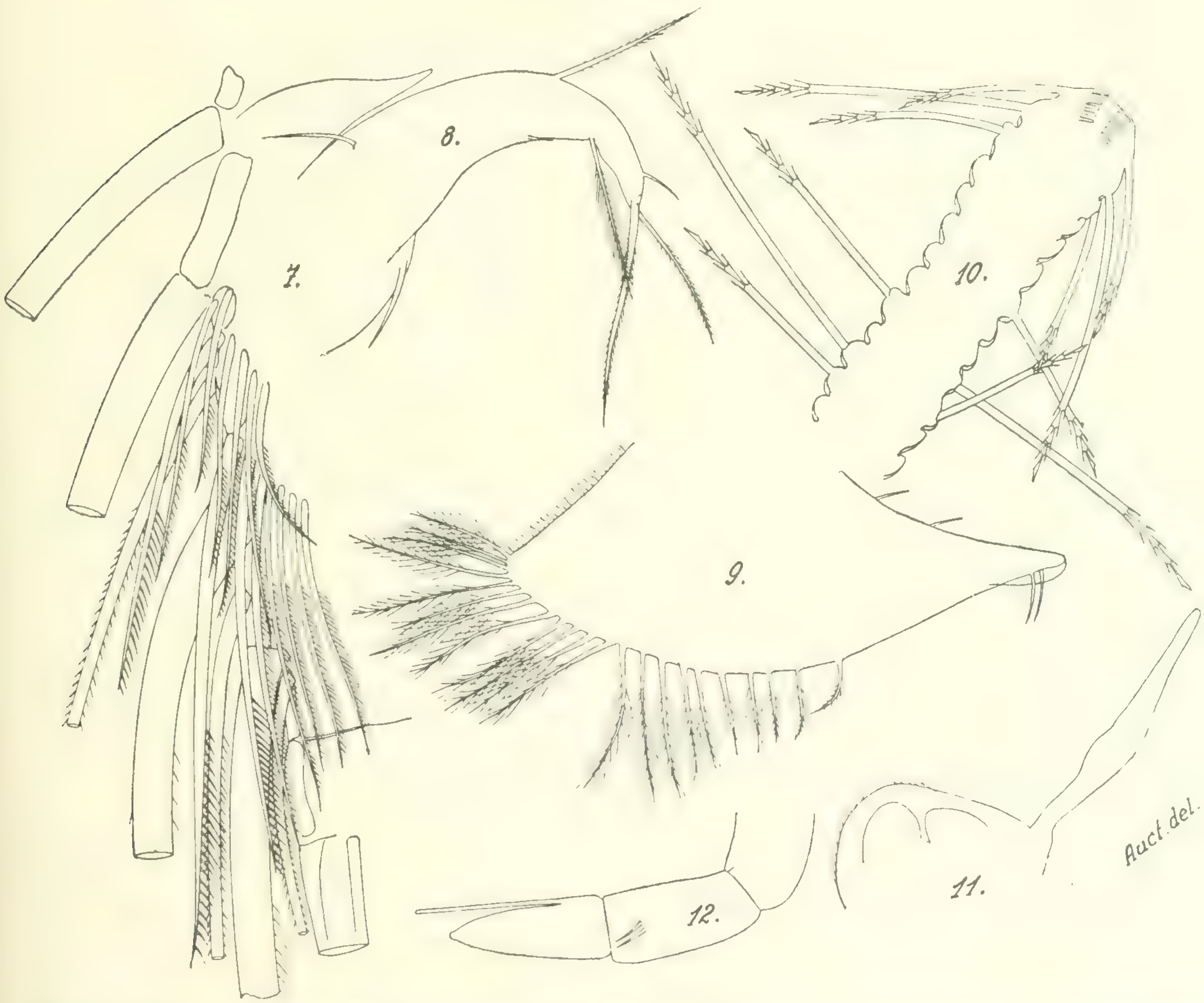

Fig. XCII. — *Asterope Ohlini* n. sp. — 7. Anterior part of the second and third endopodite joints of the right mandible seen from inside; the long bristles are broken, ♀; 480 ×. 8. Left maxilla, seen from inside, ♀; 136 ×. 9. Left sixth limb seen from inside, ♀; 120 ×. 10. Seventh limb, ♀; 200 ×. 11. Median eye and rod-shaped organ, ♀; 136 ×. 12. Second antenna, endopodite, ♂, Stage I; 160 ×.

Asterope curta n. sp.

Description: — Female: —

Shell: — Length, 1.70—1.80 mm.; length : height about 1.32 : 1; length : breadth about 1.8 : 1. Both when looked at from the side and also from beneath the shell is of about the same type as that of *A. Mülleri*, but is somewhat higher and wider in comparison; cf. the figures 1 and 2. Sometimes, however, when seen from the side, it is somewhat more sharply cut off at the back. Seen from inside: Medial bristles: On the rostrum, in the incisur and at the part just behind the latter there is a moderate number of stiff bristles; most of these are subequal and moderately long, but a few more or less short bristles may be found, especially among those situated farthest in. All these bristles are scattered; sometimes, however, the bristles that are situated on the rostrum just within the anterior margin of the shell may be said to be arranged in a sparse and not quite distinct row running about parallel to the anterior margin of the shell. Along the ventral margin of the shell there are a moderate number of rather short bristles, in most cases arranged in a simple row running about parallel to and somewhat inside the margin of the shell. Along almost the whole of the spine-bearing list and about parallel to and half way between it and the posterior margin of the shell there runs a very close and distinct row of stiff, moderately long, bristles (fig. 5). The spine-bearing list has about 24—25 hyaline spines and a thin row of short, subequal bristles, usually one or two, sometimes three between each hyaline spine. There are no wide pores on the part between the spine-bearing list and the posterior margin of the shell. An edge similar to that on the right shell of *A. spinifera* is developed in this species as well, but is somewhat weaker.

First antenna (fig. 6): — This is very like that of *A. Mülleri*. A few differences may, however, be noted. The third and fourth joints together form an almost quadratic joint and are together about as long as the total length of the fifth and sixth joints. The distal boundary of the fourth joint is rather weakly or moderately strongly concave. The third joint has only five bristles anteriorly; judging from the equipment and situation of the bristles it is bristle no. 2 of those species that have six bristles that is lacking. On bristle no. 1 there are numerous long, stiff secondary bristles ventrally, on bristles nos. 2, 3 and 5 there are a few similar secondary bristles, bristle no. 4 has short hairs. The longer of the two posterior distal bristles on the fourth joint is, as a rule, somewhat shorter than the total length of the three distal joints; in one case it was the same length as this.

Second antenna: — Distally on the inside close to the exopodite the protopodite has a very short bristle. Exopodite: The end joint has only three bristles. There is no basal spine except on the ninth joint, on which it is certainly large, but presumably very weak, as it is divided into fine hairs distally. The endopodite is distinctly three-jointed; its end bristle is slightly longer than the stem. In two cases out of five a short bristle was observed on the second joint, both on the right and on the left antenna (abnormal?; a bristle of this sort was observed by me as a rather infrequent abnormality not only in this genus but in species of the family *Cypridinidae*); cf. the accompanying figure 8.

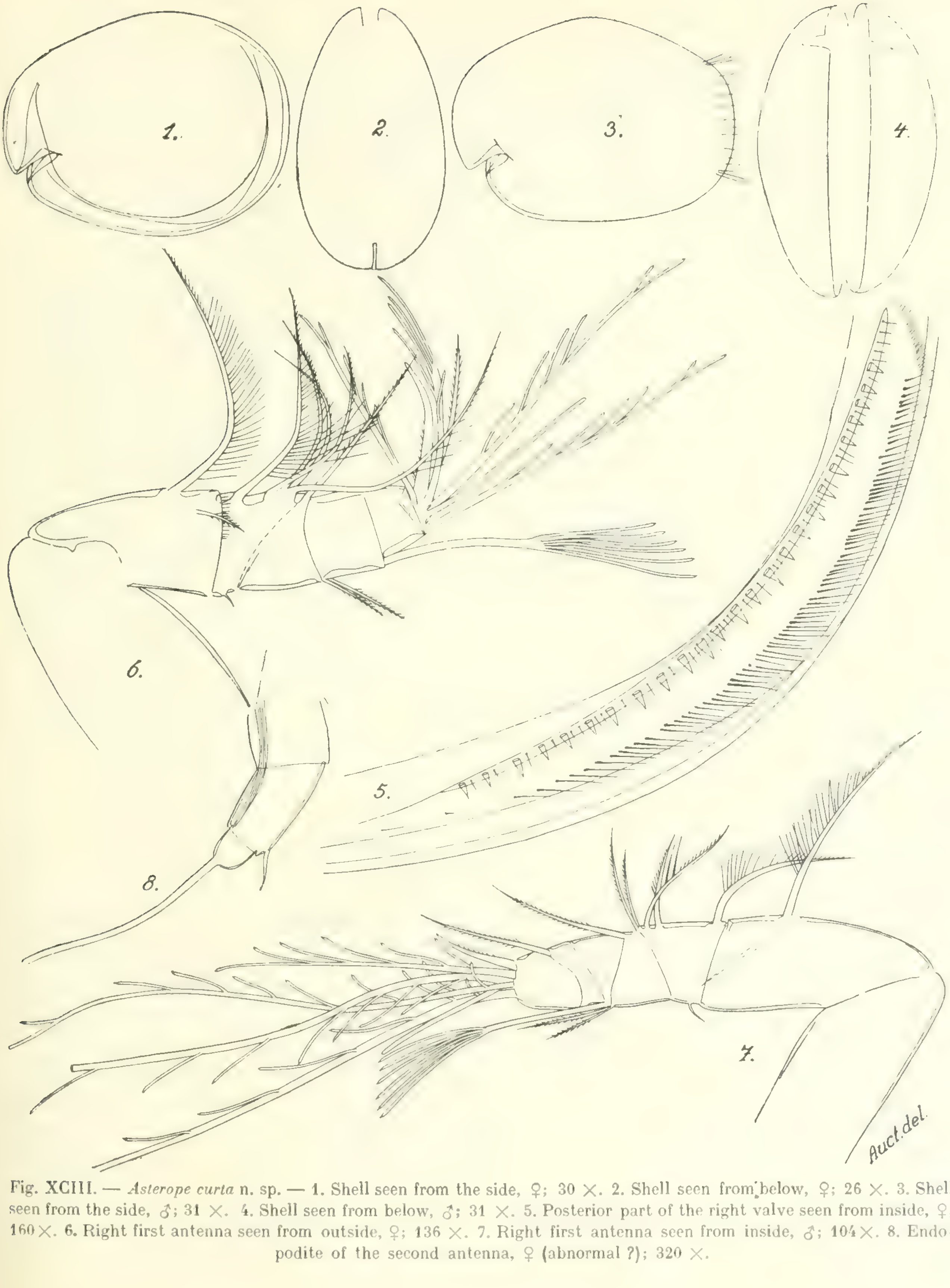

Fig. XCIII. — *Asterope curta* n. sp. — **1.** Shell seen from the side, ♀; 30 ×. **2.** Shell seen from below, ♀; 26 ×. **3.** Shell seen from the side, ♂; 31 ×. **4.** Shell seen from below, ♂; 31 ×. **5.** Posterior part of the right valve seen from inside, ♀; 160 ×. **6.** Right first antenna seen from outside, ♀; 136 ×. **7.** Right first antenna seen from inside, ♂; 104 ×. **8.** Endopodite of the second antenna, ♀ (abnormal ?); 320 ×.

M a n d i b l e: — This is very like the corresponding limb in *A. Mülleri.* We must note: P r o t o p o d i t e: Coxale: The scythe-shaped process (fig. 11): The dorsal bristle is often fixed with almost its whole length distally of the main spine and extends beyond the distal point of the process to an extent of about half its length. The dorsal serrate teeth are rather weak. The main spine is sometimes rather weak, often moderately strong. There are four ventral spines, the two proximal of which are rather strong, the two others have from two to four points and are rather weak. Between the latter and the main spine two other very weak ventral spines can sometimes be observed. Basale: The backward pointing process has four distal bristles, three or four triaena bristles and two dwarf bristles. The triaena bristles are armed with from two to five pairs of spines under the distal pair. The dorsal side of this joint has only a few groups of short, fine, stiff hairs. The e x o p o d i t e (fig. 10) is, if its two distal bristles are included, about as long as the anterior side of the first endopodite joint or else it is only slightly shorter. E n d o p o d i t e (fig. 10): Second joint: The proximal bristle is about half as long as the main bristle a. The medial cleaning bristles are comparatively few, four to six, in a distinct lower row (the number varies from one individual to another and on the right and left mandible of the same individual) and one bristle between the main bristles b and c.

M a x i l l a (fig. 12): — This is like this limb in *A. Mülleri.* The dorso-proximal bristle of the p r o t o p o d i t e is moderately long, about as long as the dorso-distal bristle. The bristle of the first e n d o p o d i t e joint is rather slightly shorter than the bristle of the end joint.

S i x t h l i m b: — The postero-ventral corner is rather broadly rounded. There are 16—20 postero- and three antero-ventral bristles. On the anterior edge of the limb there are three bristles, two of which are situated close to each other somewhat below the third.

S e v e n t h l i m b (fig. 13): — This is armed with 16—18, usually 18, cleaning bristles, six of which are, as in *A. Mülleri*, concentrated at the point of the limb, three on each side. These bristles have from two to four bells. Each end comb has from five to nine teeth; all the teeth are finely and similarly pectinated; their points are somewhat strengthened, lancet-like, about the same type as shown in fig. 13 of *A. quinquesetae.*

The f u r c a, l a t e r a l e y e s and m e d i a n e y e are similar to those of *A. Mülleri.*

M a l e: —

S h e l l: — Length, 1,60—1,61 mm. Length : height about 1,42 : 1. S e e n f r o m t h e s i d e (fig. 3) it has its greatest height about the middle and the anterior and posterior parts are of about the same height. The dorsal margin forms a well rounded hump at the middle and slopes from the middle evenly and rather decidedly forwards and backwards, about equally strongly in each direction. The ventral margin is uniformly and slightly curved. The shell is cut off rather abruptly posteriorly. The posterior margin is uniformly and moderately strongly curved with a broadly rounded line passing evenly into the ventral margin; it is bounded from the dorsal margin by a broadly round and rather weakly developed corner. The anterior margin is boldly rounded. The rostrum dominates to some extent over the part beneath the incisur. S e e n f r o m b e n e a t h (fig. 4) it has its greatest breadth just in front of the middle and the anterior part of the shell somewhat larger than the posterior part. The wreath of hair round the posterior part of the shell is rather sparse. S e e n f r o m i n s i d e, the rostrum is

somewhat narrower than that of the female. The medial bristles are similar to those of the female; those on the anterior part of the shell are, perhaps, however, somewhat fewer and longer than those of the female.

First antenna (fig. 7): — This has seven joints. The proportion between the joints is about as follows:

$$\mathrm{I}\,{}^{30}_{25};\ \mathrm{II}\,{}^{35}_{22};\ \mathrm{III}\,{}^{17}_{4};\ \mathrm{IV}\,\tfrac{3}{10};\ \mathrm{V}\,{}^{7}_{1};\ \mathrm{VI}\,{}^{7}_{4};\ \mathrm{VII}\,{}^{3}_{10}.$$

Of the five anterior bristles on the third joint nos. 2 and 5 especially are very much shortened. Of these bristles no. 1 has rather numerous long, stiff secondary bristles ventrally, no. 3 is armed with a few similar bristles, bristle no. 2 has moderately long, fine secondary bristles, the others have short hairs. The longer of the two posterior distal bristles on the fourth joint is about as long as the total length of the three following joints. The sensorial bristle of the fifth joint is of quite the same type as in the female, i. e. it has only six sensorial filaments; its stem is about as long as the posterior side of the second joint. The a-claw is finely pectinated, as in the female. The b-bristle is about as long as the anterior side of the second and third joints and, like that of the female, it has five sensorial filaments. The c- and f-bristles are subequal, about a third longer than the shell (their length was 2,3—2,4 mm.). In one specimen twenty sensorial filaments were observed on the c-bristle of each antenna, eighteen on the f-bristle (both these bristles were defective in the other specimen). The g-bristle is somewhat longer than the whole antenna; it has eight sensorial filaments.

Second antenna: — The exopodite is comparatively slightly lengthened. The relation between the joints is shown by the following numbers:

♂ (length of shell, 1,6 mm.) = I : II : (III — IX) = 40 : 11 : 22.

For the sake of comparison I give here the corresponding figures for the female, expressed on the same scale:

♀ (length of shell, 1,7 mm.) = I : II : (III — IX) = 31 : 6 : 21.

The second joint is about as long as the following two or three joints together; the third to the ninth joints are of about the same length, as is the case in the female. All the joints, thus even the end joint, are without basal spines. Endopodite (fig. 9): The three bristles on the second joint are well pointed and decrease uniformly in length; the longest is about as long as the width of this joint at the place where the bristle is fixed, the shortest one is about half as long as the longest one or somewhat more. The third joint is rather broad proximally, lancet-like, with rather broad, thin side borders. Its point has six or seven powerful, chitinized cross-ridges on the inside. Its proximal bristle is somewhat shorter than the joint.

Mandible: — Protopodite: Basale: The backward pointing process is as strongly developed as in the female; it has no perceptible reduction of the bristles. At about the middle of the dorsal side of this joint there is a single bristle of about the same length as the dorsal side of the joint. Endopodite: First joint: The shortest of the three ventral bristles is furnished at the middle with fine secondary bristles situated close together and all round the bristle; these are about as long as the long secondary bristles on the two other bristles; distally it has short hairs. On the two other bristles the short proximal secondary

Fig. XCIV. — *Asterope curta* n. sp. — 9. Endopodite of the second antenna, ♂; 248 ×. 10. Distal part of the right mandible seen from inside, ♀; 172 ×. 11. Scythe-shaped process of this limb, ♀; 480 ×. 12. Left maxilla seen from inside, ♀; 224 ×. 13. Seventh limb, ♀; 264 ×. 14. Furca, ♀; the secondary spines are not drawn; 212 ×.

bristles seem to be somewhat more numerous than in the female. Second joint: This joint has two proximal bristles, one of which is about as long as, the other about half the length of, the proximal bristle in the female. The medial cleaning bristles are somewhat more weakly equipped than those of the female. On one specimen their number was the same as in the female, on the other I found, besides the bristles observed in the female, a bristle situated somewhat inside and distally of the cleaning bristle between the main bristles b and c. The end claw is not quite so long as the anterior side of the second endopodite joint.

F u r c a (fig. 14): — This has eight claws, of which the five or six anterior ones may be counted as main claws. The anterior main claw is somewhat more strongly bent than the corresponding claw in the female and a somewhat more decided bend than in the female can sometimes also be observed in the claw or claws nearest to this one. The two posterior claws are annulated.

The l a t e r a l e y e s are somewhat larger than those of the female.

Does the male described above belong to this species?

Remarks: — It seems to me very probable that the male described above really belongs to this species, partly because the two specimens that were caught were found together with females of this species at two separate stations, partly, and of course especially, because of the very far-reaching agreement in its morphology that this male shows with the female described above. The characters that do not seem to support this affinity are the following: 1) The length of the shell: this male is shorter than the female. In all other species of this genus known so far the opposite condition has been found. 2) The bristle at the middle of the dorsal side of the second protopodite joint of the male mandible. With regard to this character it may, however, be pointed out that there is sexual dimorphism in *A. Grimaldi* in the bristles on the dorsal side of this joint. 3) The second endopodite joint of the mandible has one proximal bristle in the female, two in the male, but here too an increase in the number of these bristles was observed in the males of *A. Grimaldi.*

At any rate this seems to be the only one of all the species so far known to which this male can be assigned with any great probability.

Relation to A. glacialis G. W. Müller.

This species is certainly very closely related to the species *A. ovalis*, described by G. W. MÜLLER, 1908, p. 93, from the Antarctic, and later on named *A. glacialis* by the same author (1912, p. 47). Only the male of this species is known as yet; the original description is rather incomplete. It cannot be decided at present whether there is complete identity. The following statements about *A. glacialis* are arguments against this identity: Shell : Length 1,35 mm.; ,,Die Leiste . . . ist im ganzen Umfang glattrandig" (presumably a mistake). First antenna: The sensorial bristle of the fifth joint has only about four sensorial filaments (five are drawn in the figure, one of these filaments is evidently considered as the distal part of the bristle). The e-filament is shorter than the a-claw. The number of sensorial filaments on the b- and g-bristles. The cleaning limb has only fourteen bristles. The furca has only seven claws.

Habitat: — S o u t h G e o r g i a: S. A. E., Station 25, off Grytviken, lat. 54° 22′ S., long. 36° 27′ W., (t y p e - l o c a l i t y); 21. V. 1902; depth, 24 –52 m.; grey clay with scattered

algae: 7 mature females, 1 mature male and 8 juvenes; R. M. S. 172. S. A. E., no number of the station, Grytviken; 22. V. 1902; on an old root of *Macrocystis*: 3 mature females; R. M. S. 173. S. A. E., Station 28, mouth of Grytviken, lat. 54° 22′ S., long. 36° 28′ W.; 24. V. 1902; depth 12–15 m.; sand and algae: 6 mature females, 1 mature male and 3 larvae in the last larval stage; R. M. S. 174 and 175. S. A. E., Station 33, Grytviken, lat. 54° 22′ S., long. 36° 28′ W.; 30. V. 1902; depth 22 m.; clay with algae: one mature female; R. M. S. 176.

Type-specimen on slides in the collections of the R. M. S.

Asterope aberrata n. sp.

Description: — Female: —

Shell: — Length, 1.65—1,71 mm.; length : height about 1,94 : 1; length : breadth about 2.43 : 1. Seen from the side (fig. 1) it is of a somewhat irregular elliptical shape; the greatest height is at about the middle; the anterior and posterior ends are both comparatively low, the latter being somewhat, though only rather slightly, higher than the former. The dorsal and ventral margins are rather evenly and moderately curved, with almost the same shape, though the former is somewhat, though only rather slightly, more strongly curved than the latter; both are somewhat flattened anteriorly; they pass evenly into the anterior and posterior margins, without any corners. The anterior end is boldly and evenly rounded, the posterior end is somewhat prolonged and forms a broadly rounded corner at about half way up the shell. Seen from beneath (fig. 2) the shell is narrowly oviform with its greatest breadth just behind the middle; its posterior end is somewhat more broadly rounded than the anterior one and it has evenly curved side-contours. Seen from inside: Medial bristles: On the rostrum (fig. 3) there are a moderate number of moderately long or rather short bristles. A number of these are arranged in a more or less distinct and rather close row running about parallel to and somewhat inside the anterior margin of the shell; the others are scattered. In the incisur there are on the posterior edge of the rostrum a moderate number of moderately long, scattered bristles. In addition there is in the incisur a few scattered bristles and a close row of moderately long bristles, running somewhat inside and about parallel to the ventral margin of the rostrum. On the part just behind the incisur there are a moderate number of scattered bristles, most of which are moderately long, some, especially those situated farthest in, more or less short. Along the middle part of the ventral margin of the shell there are a moderate number of rather short bristles, arranged in a distinct row running about parallel to and somewhat inside the margin of the shell. This row of bristles becomes somewhat more dense posteriorly and at the same time the bristles become somewhat longer; it continues along almost the whole of the spine-bearing list, running about parallel to and somewhat inside the margin of the shell (fig. 4); in its dorsal part it becomes more sparse than it is ventrally. The spine-bearing list has about 26–28 hyaline spines varying somewhat in size and a very sparse row of short bristles, usually one bristle between each hyaline spine; between a number of the hyaline spines, however, there are sometimes no bristles. About parallel to and half way between the bristle-bearing list and

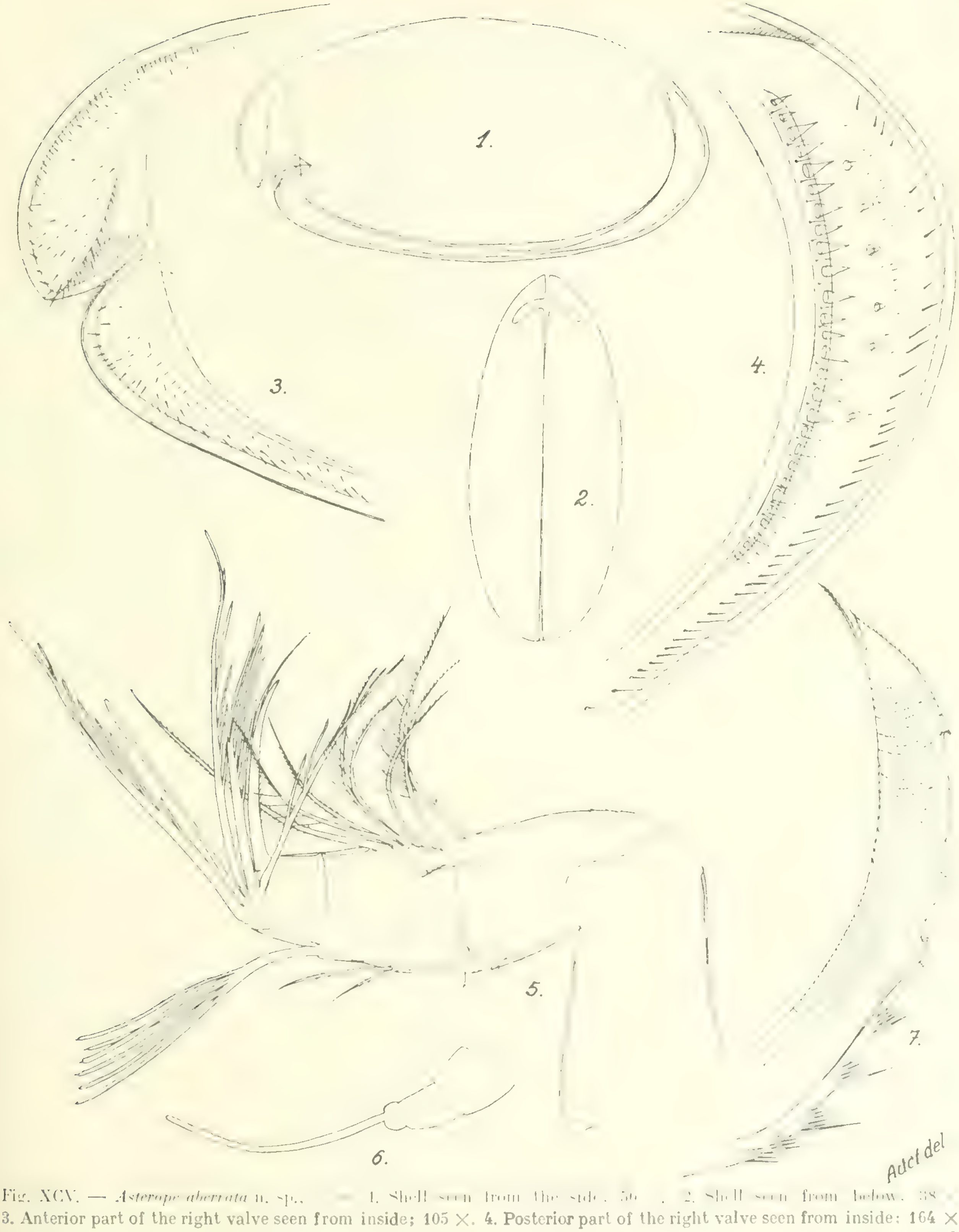

Fig. XCV. — *Asterope aberrata* n. sp., — 1. Shell seen from the side; 56 ×. 2. Shell seen from below; 38 ×. 3. Anterior part of the right valve seen from inside; 105 ×. 4. Posterior part of the right valve seen from inside: 164 ×. 5. Left first antenna seen from outside; 185 ×. 6. Endopodite of the second antenna; 312 ×. 7 Endite of the coxale of the mandible: 480 ×.

the margin of the shell there is a sparse row of broad pores (six such pores were observed). Outside this row a not inconsiderable number of fine pores are scattered. On the other hand there is no such ridge as is described for *A. norvegica*.

First antenna (fig. 5): — This has six joints; the third and fourth joints are united, but yet the original boundary between these joints can, at least partly, be still traced. These two joints are very much shortened; together they form a joint that is much shorter than its height, only about as long as the original fifth joint. The distal boundary of the original fourth joint is very decidedly concave. The anterior bristle of the second joint is somewhat longer than the anterior side of this joint. The original third joint has six anterior bristles: Of these bristles nos. 3 and 4, like nos. 5 and 6, are situated at the side of each other; bristles nos. 1, 2, 3, 4 and 6 have long, stiff secondary bristles ventrally, no. 5 has short hairs. The longer of the two posterior distal bristles on the fourth joint is not quite so long as the total length of the two following joints. The sensorial bristle of the fifth joint is comparatively short; its stem is not quite so long as the two penultimate joints; it has six sensorial filaments. The end joint has six bristles, the d-bristle is reduced. The a-claw is unusually long, being almost as long as the total length of the third to the fifth (definite) joints; dorsally it is weakly pectinated at the middle. The e-bristle has six, the f-bristle four or five and the g-bristle five sensorial filaments. Pilosity: The first and second joints have only very slight pilosity developed; the first joint is furnished with hairs ventero-medially; the second joint has hairs proximo-anteriorly and disto-posteriorly, especially on the inside of the antenna; the latter joint has no hairs on the distal boundary.

Second antenna: — The protopodite has a short bristle disto-medially near the exopodite. The end joint of the exopodite has only three bristles, two long ones and a rather short one. This joint has a reduced basal spine, which is sharply cut off at the point and split into short hairs; apart from this the exopodite is quite without basal spines. The bristle of the second joint of this branch has unusually long, fine secondary bristles, which are almost as long as the natatory hairs on the following bristles. The endopodite (fig. 6) is only weakly three-jointed; its end bristle is about one and a half times the length of the stem.

Mandible: — This is very like this limb of *A. Mülleri.* We may note: Protopodite: Coxale: The scythe-shaped process (fig. 7): The distance from the point of the process to the main spine is not inconsiderably shorter than the distance from the latter to the proximal ventral spine. The dorsal bristle is placed considerably nearer the point of the process than its distance from the main spine and is about as far distally from the latter as its own length. The main spine is, like its ridge of bristles, very weakly developed. There are four ventral spines, the two distal of which are rather weak, and distally of these two or three very weak ones. Basale: The backward pointing process has three or four distal bristles, only one or two triaena bristles and two dwarf bristles. The triaena bristles have from five to eleven pairs of secondary spines proximally of the pair of strong distal spines. The glands of this process emerge on an almost entirely reduced verruca. At about the middle of the dorsal side of this joint there is a single bristle which is about as long as the dorsal side of the joint (fig. 8) (on

one of the two specimens investigated — the type-specimen — it was only developed on the right mandible). In addition there are dorsally on the outside of this joint a few groups of short, fine, stiff hairs. Of the two dorso-distal bristles on this joint the shorter one is only about as long as the dorsal side of the joint. The e x o p o d i t e (fig. 8) is, if its two end bristles are included, about two-thirds of the length of the anterior side of the first endopodite joint. E n d o p o d i t e (fig. 8): First joint: The two longest of the three ventral bristles have no short secondary bristles proximally of the long secondary bristles. Second joint: The proximal bristle is not quite half as long as the main bristle a. There are five cleaning bristles in a distinct lower row and one cleaning bristle between the main bristles b and c; on the mandible of the right side there was, in addition, on one of the two specimens investigated (not on the type-

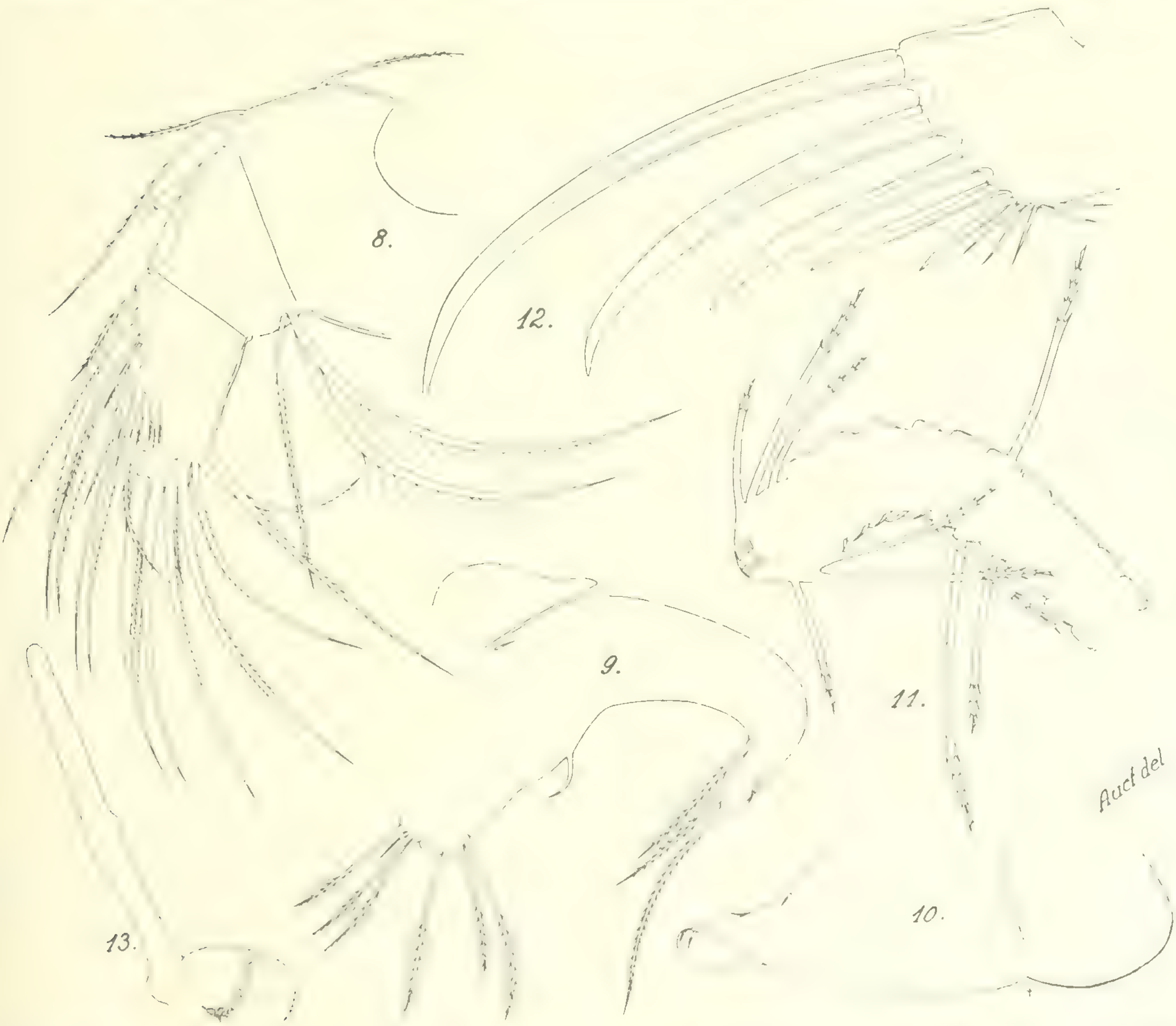

Fig. XCVI. — *Asterope aberrata* n. sp., ♀. — 8, Right mandible seen from inside. 196 ×. 9, Left maxilla seen from inside. 240 ×. 10, Right sixth limb seen from inside. 132 ×. 11, Seventh limb. 280 ×. 12, Furca; the secondary spines are not drawn. 280 ×. 13, Medial eye and the rod-shaped organ. 225 ×.

specimen, the figure is drawn from the former specimen) a short bristle below and between the two inner bristles in the lower row. The end claw is powerful and about as long as the anterior side of the two distal joints; it is rather weakly pectinated.

M a x i l l a (fig. 9): — P r o t o p o d i t e: The distal endite has three bristles, the middle one of which is somewhat shorter than the two others. The dorso-proximal bristle is very short. The basale has one ventral bristle of moderate length. On the other hand this joint has no short ventero-distal bristle or dorso-distal bristle. E n d o p o d i t e: The posterior distal bristle of the first joint is rather slightly more than half the length of the bristle of the end joint.

S i x t h l i m b (fig. 10): — This is very broad, with a broadly rounded postero-ventral corner. It is quite different from all the other species of this genus dealt with in this treatise because there are no posterior ventral bristles at all. On the other hand there are two anterior ventral bristles and two bristles are developed on the anterior edge of the limb. Along the ventral margin there are only close, fine, stiff, rather short hairs, of which those situated behind the sinuosity denoted by a cross on the accompanying figure are distinctly more sparse, shorter and finer than those in front of this sinuosity. The part behind the sinuosity seems to be thinner and more hyaline than the anterior part.

S e v e n t h l i m b (fig. 11): — This has ten cleaning bristles, of moderate and somewhat different lengths; six of these are situated close together distally, three on each side, and four are scattered somewhat proximally of the former, three on one side, one on the other. Each cleaning bristle is armed with from two to four bells. Each end comb consists of from eight to ten similar, weak, teeth, evenly and finely pectinated and strengthened into a somewhat lancet-like shape distally.

The f u r c a (fig. 12) has ten claws, of which the five anterior ones may be denoted as main claws. The second to the fifth main claws differ somewhat in shape from the type that is usually characteristic of species of this genus, as they are considerably less bent, especially the posterior ones. The two anterior main claws have no ventero-basal spines. The secondary claws are not annulated.

The l a t e r a l e y e s are well developed. The m e d i a n e y e (fig. 13) has a few short, fine hairs.

The m a l e is unknown.

Remarks: — In order to verify by investigation the description of *A. Mariae* (W. BAIRD) I wrote to Professor G. S. BRADY for specimens of this species. A tube containing five specimens, labelled *A. Mariae* in the writing of Professor BRADY, was kindly sent to me in answer to my application. Even a rather hasty investigation of the shape of the shell was enough to show me that among these individuals there were representatives of two quite distinct species. Four of them, two mature females and two larvae, belonged to the species described by me above, the remaining one was a larva whose shell certainly agreed in shape with that of *A. Mariae* but which proved, on careful examination, to belong presumably to *A. norvegica*. (For *A. Mariae* see the remark under *A. Grimaldi* var. *vicina*, pp. 518—522 of this treatise.)

A. aberrata is probably very closely related to the species that was described by G. O. SARS, 1887, p. 28, under the name of *A. elliptica* PHILIPPI. This species is stated by this writer partly to have been caught at Messina (thus near Palermo, the type locality for this species of PHILIPPI's*) and partly at Cape Breton in the Bay of Biscay. There does not seem to be full identity, however, as the species described by G. O. SARS has, according to pl. IV, fig. 1, numerous (23) posterior ventral bristles on the sixth limb and thirteen bristles on the seventh limb. It does not seem impossible, however, that these and some other rather small differences may be due to the somewhat superficial way in which G. O. SARS has described and reproduced this form. In order to verify these statements of G. O. SARS's I wrote to this author and asked for the type specimen of his re-description. In answer to my request Professor SARS informed me that all his specimens of this species had unfortunately been lost, apparently without any hope of their ever being found again. *Relations to other species.*

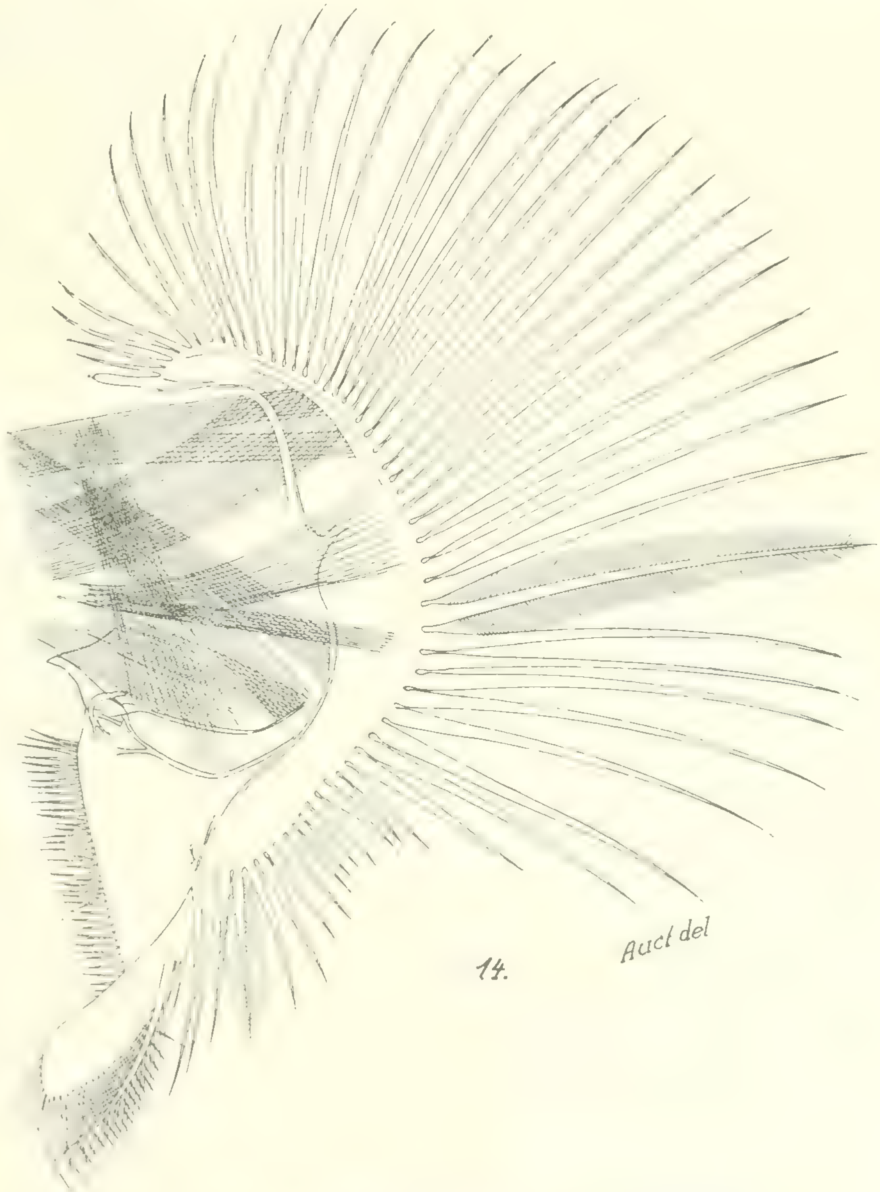

Fig. XCVII. *Asterope aberrata* n. sp., . 14. Fifth limb. 20 .

For the possibility of identifying A. PHILIPPI's species *A. elliptica* see above, p. 468.

G. S. BRADY and A. M. NORMAN describe, 1896, p. 634, under the name of *A. elliptica* A. PHILIPPI, a form from Valentia, Ireland, i. e. from a locality not far from the type locality for the species described by me above. This form is also certainly very closely related to this species of mine, but differs so essentially from it in the shape of the shell (pl. LII, figs. 16 and 17)

* G. O. SARS states, 1887, p. 30, by an oversight, that the type locality was the Bay of Naples.

and the limbs (pl. LIX, figs. 19 and 20) that it must be said that synonymization is impossible. We have perhaps here too, however, mistakes in observation and drawing on the part of the authors — it is certain that the limbs are exceedingly incorrectly drawn — nor does it seem impossible, as I point out in the remark under *A. abyssicola*, that in pl. LII there has been confusion between figures 17 and 19. — This species described by these writers cannot be synonymized with the above-mentioned species of G. O. SARS's either. Nor does G. W. MÜLLER, 1912, p. 46, include it as a synonym of *A. elliptica*.*

Habitat: — Ireland: Strangford Lough (type locality); no information about the depth and the nature of the bottom was to be found on the label: 2 mature females and 2 juvenes; coll. G. S. BRADY.

Type specimen on slides in the collections of the R. M. S.

Asterope Grimaldi n. sp.

Description: — Female: —

Shell: — Length, 1,53—1,7 mm.; length : height about 2,2 : 1; length : breadth about 2,4 : 1. Seen from the side (fig. 1) it is very much elongated with the greatest height at about the middle and with the anterior and posterior parts of about the same height. The dorsal and ventral margins are almost parallel and are very weakly, uniformly and almost symmetrically curved, the ventral margin is, however, as a rule, somewhat flattened anteriorly. These margins pass evenly into the anterior and posterior margins without forming any corners. The anterior and posterior margins are boldly rounded, almost into semi-circles, and have about the same shape; the latter is, however, somewhat flattened dorsally in most cases. Seen from beneath (fig. 2) it is narrow and oviform, with its greatest breadth at about two-thirds of the distance along the shell; the posterior end is rounded somewhat more broadly than the anterior end and the side contours are evenly curved. Seen from inside: Medial bristles: On the rostrum there is a sparse row of stiff and moderately long bristles, running parallel to and somewhat inside the anterior margin of the shell. Within these there are a moderate number or rather few scattered bristles, most of them short, some about as long as the bristles in the anterior row. In the incisur there are a few stiff and moderately long bristles, a number of which are scattered, and some are often arranged in a sparse row running about parallel to and somewhat inside the ventral margin of the rostrum. On the part just behind the incisur there are also a moderate number or rather few bristles. Some of these are often placed in a sparse row running about parallel to and somewhat inside the ventral margin; these bristles are moderately long. The others that are situated farther in are scattered and more or less short. About parallel to and somewhat within the ventral margin of the shell there is a row of rather short bristles, which is partly very sparse and sometimes not very distinct.

* *A.* [illegible] is also found by E. GRAEFFE, 1900, p. 35. No description is given and it is consequently quite impossible to say anything about the synonymy of this form.

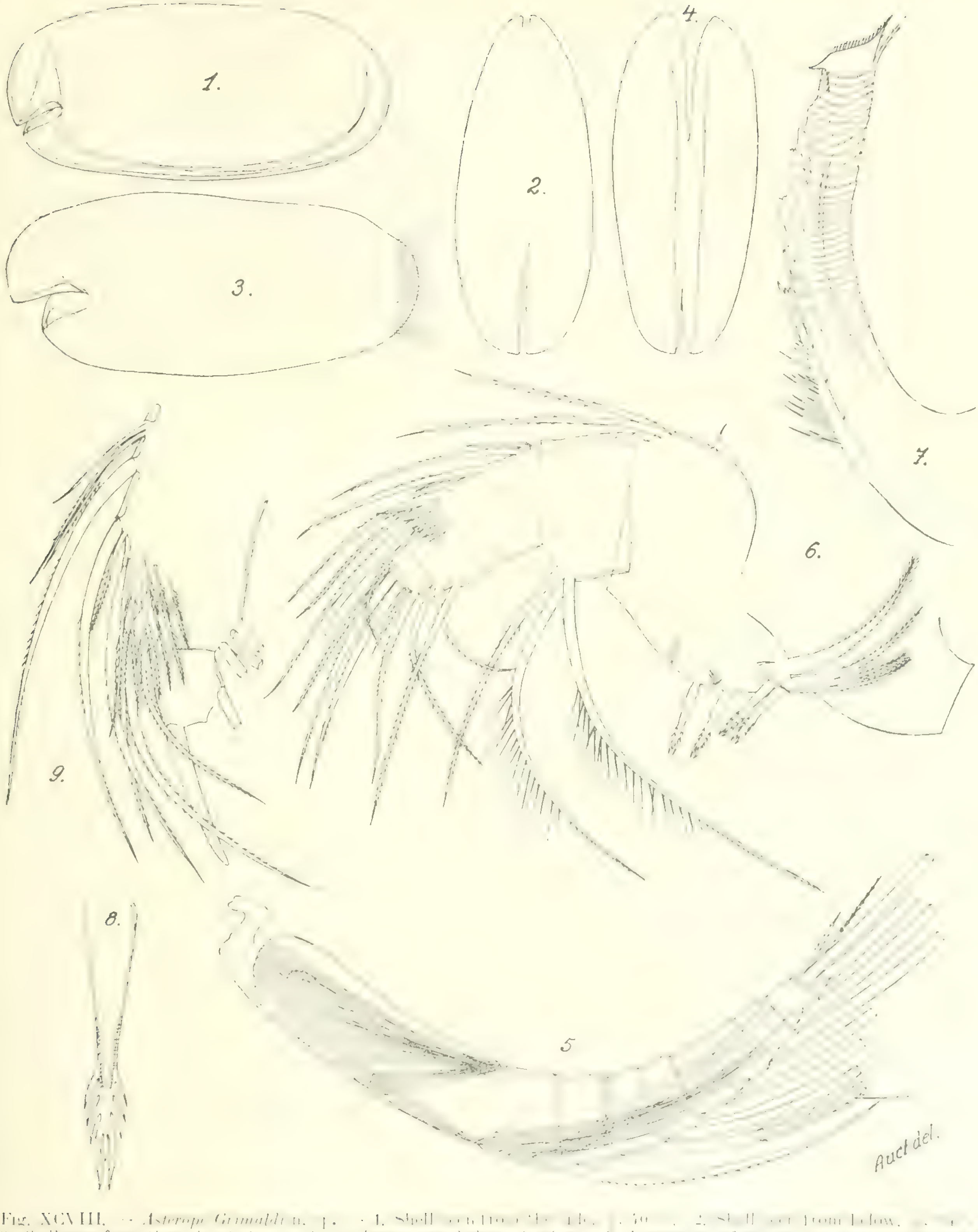

Fig. XCVIII. — *Asterope Grimaldii* n. sp. — 1. Shell seen from the side, ♀; 50 ×. 2. Shell seen from below, [illegible]. 3. Shell seen from the side, ♂; 50 ×. 4. Shell seen from below, [illegible]. 5. Exopodite of the right second antenna seen from outside, the long bristles are broken, ♀; 332 ×. 6. Right mandible seen from inside, ♀; 208 ×. 7. Endite of the coxale of this limb, ♀; 448 ×. 8. Triaena bristle of this limb, ♀; 560 ×. 9. Second and third endopodite joints of the right mandible seen from inside, the posterior bristles broken, [illegible].

Somewhat antero-ventrally of the spine-bearing list this row becomes denser and at the same time its bristles become somewhat longer; it continues along the ventral third or half of the spine-bearing list, running about half-way between and parallel to the spine-bearing list and the margin of the shell. Apart from this there are no medial bristles at all on the part between the spine-bearing list and the margin of the shell (— fig. 1 of *A. Grimaldi* var. *vicina*). The spine-bearing list has rather few hyaline spines — only 18—22 were observed — and a thin row of short bristles, one or two bristles to each hyaline spine. Somewhat within and about parallel to the posterior margin of the shell there runs along the dorsal third or half of the spine-bearing list a sparse row of broad pores; five or six of these were observed. Close to these broad pores there are numerous fine pores, arranged in a close and very irregular row extending from a point somewhat ventrally of the ventral broad pore up to the dorsal boundary of the spine-bearing list. On the part between the spine-bearing list and the posterior margin of the shell there is no ridge such as is described for *A. norvegica*.

First antenna (fig. 10): — This has six joints; the original third and fourth joints are united, although the boundary between them can still be traced. These two joints form together an almost quadratic joint, which is about as long as the two following joints together and which has a distal boundary that is only slightly concave, almost straight. The anterior bristle of the second joint is somewhat shorter than the anterior side of this joint. The original third joint has six anterior bristles, of which nos. 5 and 6 are attached at the side of each other. Bristles nos. 1, 2, 4 and 5 are armed with long, stiff secondary bristles, which are placed pretty well on all sides on bristle no. 5 and on the ventral sides of the others. Bristles nos. 3 and 6 have at the middle somewhat shorter and finer secondary bristles than those on the four last-mentioned bristles; they are often pressed close to the bristle, so that it seems to have no long secondary bristles. The longer of the two postero-distal bristles on the original fourth joint is about as long as or somewhat longer than the total length of the three distal joints. The stem of the sensorial bristle of the fifth joint is relatively short, about as long as the total length of the three distal joints; it has seven sensorial filaments. The a-claw is somewhat shorter than the total length of the dorsal sides of the two joints next to the distal one; it is smooth. The d-bristle is reduced. The f-bristle has four or five, usually five, sensorial filaments; the c- and g-bristles sometimes have six filaments each, often (in five out of the eight individuals investigated) five sensorial filaments were observed on the c-bristle and six on the g-bristle. Pilosity: First joint: There is sparse pilosity dorso-distally and ventero-disto-medially. The second joint is sparsely furnished with hairs, especially postero-medially; there are no hairs distally on this joint.

Second antenna (fig. 5): — The protopodite does not possess disto-medially near the exopodite the bristle that characterizes this joint in other species of this genus that are dealt with in this work. The end joint of the exopodite has four bristles. The fourth to the ninth joints of this branch have basal spines. The endopodite is weakly three-jointed; its end bristle is about as long as the stem.

Mandible (fig. 6, 7 and 8): — Protopodite: Coxale: The scythe-shaped process: The part situated distally of the main spine grows rapidly narrower into a fine point; its ventral edge is somewhat concave and has a decided corner near the main spine. The distance from

the point of the process to the main tooth is considerably less than the distance from the latter to the proximal ventral spine. The dorsal bristle is attached at about the same distance from the point of the process as its distance from the main spine and is almost opposite the latter; it extends somewhat distally of the point of the process. The dorsal serrate teeth are rather weak. The main spine is moderately developed. There are five ventral spines, of which the proximal and the distal ones are rather weak. On the part distally of the main spine there are no transverse rows of hairs at all. The rod-shaped process has three short distal spines. Basale: The backward pointing process has four distal bristles, four or five triaena bristles and two dwarf bristles. The triaena bristles have from two to five pairs of spines proximally of the distal pair of main spines. The glands of this process emerge on quite a reduced verruca. At about the middle of the dorsal side of this joint there is on the left mandible one, on the right mandible two, short bristles; two such bristles are seldom found on both the right and the left mandible; in most cases there seem to be no hairs at all on the dorsal side of this joint. E x o p o d i t e: This is very small, only about a quarter to a sixth of the length of the anterior side of the first endopodite joint. E n d o p o d i t e: First joint: The shortest of the three ventral bristles has short hairs, the two longer ones have no short secondary bristles proximally of the long ones. This joint is not armed antero-distally with chitinous spines. Second joint: This has only one proximal bristle, which is about a third of the length of the main bristle a or somewhat shorter. Close to the proximal bristle there is a cluster of short fine hairs. No long, narrow bristle with short hairs is found between the main bristles b and c. The medial cleaning bristles are relatively few and short, and differ somewhat in number both from one individual to another and on the left and right mandibles of the same individual; four to six were observed in a distinct lower row and one close to the main bristle b. The end claw is strong but comparatively short, slightly more than twice as long as the end joint; it is smooth.

M a x i l l a (fig. 13—15): — P r o t o p o d i t e: The distal endite has three subequal bristles. The dorso-proximal bristle is very short, almost entirely reduced. The basale has one ventral bristle and one dorso-distal bristle, both relatively short and subequal; the short ventero-distal bristle is developed sometimes, but often seems to be lacking. E n d o p o d i t e: The postero-distal bristle of the first joint is somewhat shorter than the bristle of the end joint.

S i x t h l i m b (fig. 16): — This has a rather broadly rounded posterior corner. There are 17—25 posterior and seven anterior ventral bristles; on the anterior edge of the limb there are two bristles.

S e v e n t h l i m b: — This has twelve cleaning bristles, six of which are situated close together distally, three on each side, and six scattered somewhat proximally of the former ones, three on each side. Each cleaning bristle is armed with from two to five bells. Each end comb consists of from 14 to 16 teeth, all of which are evenly and finely pectinated and somewhat strengthened distally (about the same as in fig. 13 of *A. quinquesetae*).

F u r c a (fig. 17): — This has ten claws, of which the six or seven anterior ones may be called main claws. On the two or three anterior main claws there are some — the number varies to some extent — irregular, rounded small teeth ventero-proximally. (These do not form a direct continuation of the rows of fine, sharp ventral teeth that are usually developed in the

Fig. XCIX. — [illegible]. — 10. Left first antenna seen from outside, × 177. — 11. Left first antenna [illegible]. The dotted lines mark the boundaries between the joints on the lateral side of the limb, the long bristles are broken. 160. — 12. Distal part of the left first antenna seen from outside, ♀ stage I. 256.

species of this genus, as the latter stop a good distance distally of the nodous teeth.) The secondary claws never seem to be annulated.

The lateral eyes are well developed. The median eye is bare.

Male: —

Shell: — Length, 1,7—1,75 mm.; length : height about 2,27 : 1. Seen from the side (fig. 3) it has the same elongated type as the female, but is somewhat less regular. Its greatest height is at about a third of the way along the shell and the anterior part of the shell dominates to some extent over the posterior part. The dorsal and ventral margins converge gently backwards from the point where the shell is highest. The dorsal margin is somewhat irregular, it is somewhat flattened anteriorly and is characterized by a gentle and broad arcuation somewhat in front of the middle of the shell and a similar arcuation just in front of the place where it passes into the posterior margin. The ventral margin is slightly and almost evenly arched, somewhat flattened anteriorly. The posterior margin is evenly and rather strongly curved, passing into the ventral margin with a broadly and evenly rounded line; it is bounded from the dorsal margin by a broadly rounded corner, which is only slightly distinct. The anterior margin is boldly rounded and passes evenly into the dorsal and ventral margins. The part situated ventrally of the incisur is about as large as the rostrum. Seen from below (fig. 4) it is narrowly oviform with its greatest breadth at about a third of the distance along and the anterior part somewhat larger than the posterior part. The wreath of hairs round the posterior part of the shell is rather dense. Seen from inside: The medial bristles are perhaps somewhat fewer than in the female. Otherwise the shells are alike in both sexes.

First antenna (fig. 11): — This has seven joints. The proportion between the joints are about the same as in *A. norvegica*; cf. the description of the genus. Of the anterior bristles on the third joint nos. 3 and 6 especially are very much shortened; the equipment of these bristles is about the same as in the female, only somewhat weaker. The longer of the two posterior distal bristles on the fourth joint is considerably shorter than the total length of the three distal joints; even calculated absolutely it is in most cases somewhat shorter than that of the female. The sensory bristle of the fifth joint is very much more powerfully developed than in the female; its stem is thick and about as long as or somewhat longer than the total length of the three distal joints; it has very numerous sensorial filaments. The a-claw is smooth. The b-bristle is about as long as the anterior side of the second joint or is somewhat shorter; it has six sensorial filaments. The e- and f-bristles are subequal and are about one and a half times the length of the shell; a length of 2,5—2,7 mm. was observed; the e-bristle has 25—29, the f-bristle 23—26 sensorial filaments. The g-bristle is about as long as the anterior side of the second and third joints; it has nine sensorial filaments.

Second antenna: — The exopodite is very much lengthened relatively; its two proximal joints especially are considerably longer than the corresponding joints in the female. The relation between the lengths of the joints is shown by the following figures:

, (shell 1,7 mm. long) I : II : (III—IX) = 34 : 17 : 22.

For the sake of comparison the corresponding figures are given for the female, calculated on the same scale:

(shell 1.63 mm. long) I : II : (III—IX) 18.5 : 4 : 16.

The second joint is about as long as four or five of the following joints; the third to the ninth joints are, as in the female, all of about the same length. The fourth to the ninth joints

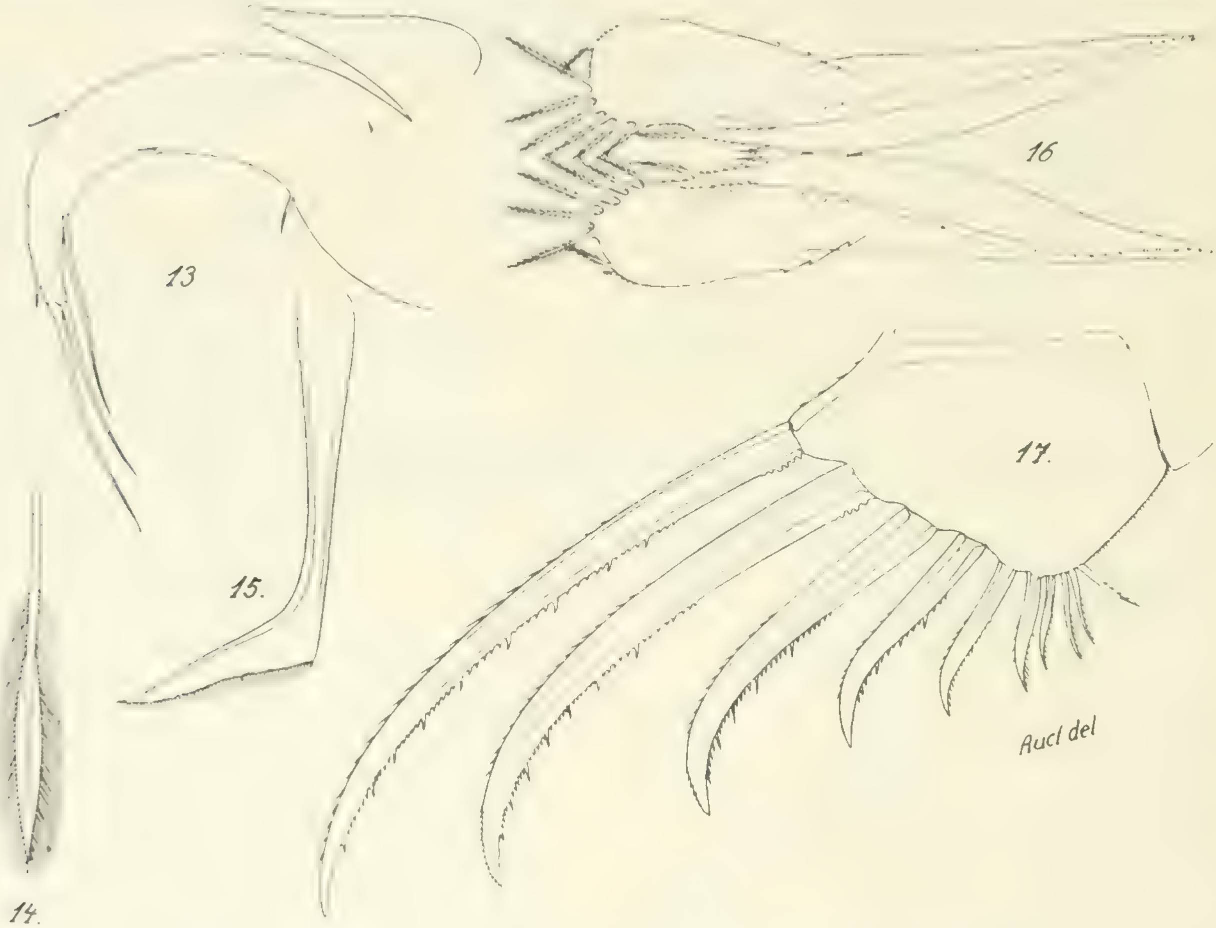

Fig. C. — *Asterope Grimaldi* n. sp., ♀. — 13. Right maxilla, seen from inside; 224 ×. 14. Distal part of a baleen bristle of a maxilla; only the hairs on the most distal part are drawn; 1520 ×. 15. The posterior bristle of the baleen of the maxilla; 720 ×. 16. The sixth pair of limbs seen from below; 192 ×. 17. Furca; 332 ×.

have exceedingly weak basal spines, sometimes scarcely perceptible. Endopodite: The second joint has three finely pointed bristles; these bristles are of moderate and somewhat different lengths; the longest is about as long as or somewhat shorter than the breadth of the joint at the place where this bristle is attached, the shortest is about half as long as this or slightly more. Somewhat proximo-medially of these bristles there is a low peg. The third joint is rather broad, lancet-shaped, and has rather broad, thin side borders (of about the same type as in *A. curta*). On the inside at the point this joint has three or four weak transverse chitinous ridges. The proximal bristle on this joint is rather long, in most cases somewhat

more than half as long as this joint; it has a strong bend near the base (as shown in fig. 55, pl. 4, *A. oblonga*, G. W. MÜLLER, 1894).

M a n d i b l e (fig. 9): — P r o t o p o d i t e: Basale: The backward pointing process has the same number of bristles as in the female, but all of them except the dwarf bristles are much weaker than those of the female and are almost smooth, with only short, fine, scarcely visible hairs. In the middle of the dorsal side of this joint there is only one bristle both on the right and the left mandible; this bristle is in most cases somewhat more than twice the length of the corresponding bristle in the female. E n d o p o d i t e: First joint: The shortest of the three ventral bristles is furnished at the middle with fine hairs scattered on all sides; these are not quite so long as the long secondary bristles on the two other of these bristles. Second joint: This has three proximal bristles of somewhat different lengths; the longest is about half as long as the main bristle a, the shortest is in most cases somewhat less than half the length of the longest. The medial cleaning bristles are considerably longer and somewhat more weakly equipped than those of the female. They are also somewhat more numerous; the following numbers were observed: six bristles in a distinct lower row, three to five bristles in a sparse and sometimes rather irregular upper row. To judge from its position the anterior bristle in the upper row certainly corresponds to the bristle „close to the main bristle b" of the female. The end claw is perhaps slightly shorter than that of the female.

The f u r c a has nine claws, of which the six or seven anterior ones may be termed main claws. The anterior ones are somewhat more decidedly bent than in the female (about the same as in fig. 14 of *A. curta*).

The l a t e r a l e y e s are somewhat larger than those of the female.

Occurrence of mature females

Remarks: — In all the samples in which more than one mature female occurred there were to be found females with as well as without eggs or embryos; the first category was, however, always in the majority.

Proportion between males and females

The male and the female juvenes of the first larval stage occurred in about the proportion 3 : 1 in the sample collected on the 1st of March; in the other samples the male and the female juvenes of this stage were about equal in number or the males were about twice as numerous as the females. In the second larval stage too the males were stated to be in the majority.

Habitat: — M o n a c o: In the harbour, (t y p e - l o c a l i t y); depth about 10 m.; fine clay with detritus: 1. III. 1916: 3 mature males, 5 mature females and 25 juvenes in different stages; R. M. S. 178 and 179. 8. III. 1916: 2 mature females and 20 juvenes in different stages; R. M. S. 180. 5. IV. 1916: 1 mature female and 4 juvenes; R. M. S. 181. 19. IV. 1916: 2 mature females and some juvenes in different stages; R. M. S. 182 and 183. (Auctor coll.)

Type specimen on slides in the collections of the R. M. S.

Asterope Grimaldi n. sp. var. vicina n. var.

Cylindroleberis oblonga. G. W. MÜLLER, 1894, p. 219, pl. 4, figs. 14—18, 39, 41, 44, 49—55, pl. 5, figs. 1, 4, 5, 13, 14, 23, 33, 41—44, pl. 8, fig. 4.
Asterope Mariae (part.). G. W. MÜLLER, 1912, p. 45.

Description: — Female: —

Shell: — Length, 1.54—2 mm. (the type-specimen, from Villefranche-sur-mer, measured 1.93 mm.). It agrees very closely with the type species except with regard to the fine pores on the part between the spine-bearing list and the posterior margin of the shell; these are considerably fewer than in the type species, about four to six near each broad pore, fig. 1.

First antenna: — The f-bristle has five, the c- and g-bristles six sensorial filaments.

Mandible: — The second protopodite joint has dorsally only the two distal bristles that are characteristic of the *Asteropidae*; on the other hand there are no bristles at all at the middle of the dorsal side. Endopodite: Second joint: The female examined had the following number of cleaning bristles: The right mandible had six bristles in a distinct lower row, one bristle close to the main bristle b and one obliquely distally inside the last-mentioned one. The left mandible had six bristles in a distinct lower row, one between the main bristles b and c and one somewhat inside the main bristle b.

The sixth limb has 27—28 posterior ventral bristles.

In other respects it agrees with the type species.

Male: — See G. W. MÜLLER loc. cit.

Remarks: — In order to make a verificatory examination I applied to Professor G. W. MÜLLER for a mature female of the species from the Bay of Naples, which he has dealt with on p. 219 of his large Ostracod monograph, 1894, under the name of *Cylindroleberis oblonga*. Professor MÜLLER kindly sent me a Naples specimen of this form. Although unfortunately this specimen was not mature — it was a male in the last larval stage — yet my synonymization given above, the result of a careful examination of this specimen, may be considered, if not as absolutely certain, at least as being fairly certain. The only character in which the Naples specimen differed from the form investigated by me was that its right mandible had three, not two, dwarf bristles on the backward pointing process on the second protopodite joint. As all the other species in this group of forms — *A. Grimaldi*, *norvegica* and *oculata* — have two dwarf bristles on this process it does not seem impossible that we are concerned here with an accidental variation. At any rate it did not seem to me that this character ought to prevent this synonymization.

It follows from this synonymization that G. W. MÜLLER's description and figures of this species are in a number of respects — even in the characters of the genus — somewhat incorrect. The mistakes will be seen by a comparison with the information I have given above.

G. W. MÜLLER in his work of 1912, p. 45 includes a species *Asterope Mariae* (W. BAIRD). The following forms are synonymized with it: *Cypridina Mariae*, W. BAIRD, 1850 c, *Cypridina oblonga*, E. GRUBE, 1859, *Cylindroleberis Mariae*, G. S. BRADY, 1868 b, *Copechaete elongata* + ?

C. affinis, E. HESSE, 1878, *Asterope oblonga*, G. O. SARS, 1887 and *Cylindroleberis oblonga*, G. W. MÜLLER, 1894. In his work of 1894, p. 219 this author does not include in his list of synonyms of *Cylindroleberis oblonga* E. HESSE's two species mentioned above and the synonyms *Cypridina Mariae*, W. BAIRD, 1850 c, and *Cylindroleberis Mariae*, G. S. BRADY, 1868 b, are denoted with a query as being doubtful.

G. S. BRADY and A. M. NORMAN discuss in their work of 1896, p. 630 a species *Asterope Mariae*. With it they synonymize all the above-mentioned species included by G. W. MÜLLER, 1912 with the exception of E. HESSE's two *Copechaete* species; all the synonymizations are denoted as certain. — Other authors as well who deal with these forms, J. A. CUSHMAN, 1906, CH. JUDAY, 1907 and R. W. SHARPE, 1909 make the same synonymization as G. S. BRADY and A. M. NORMAN.

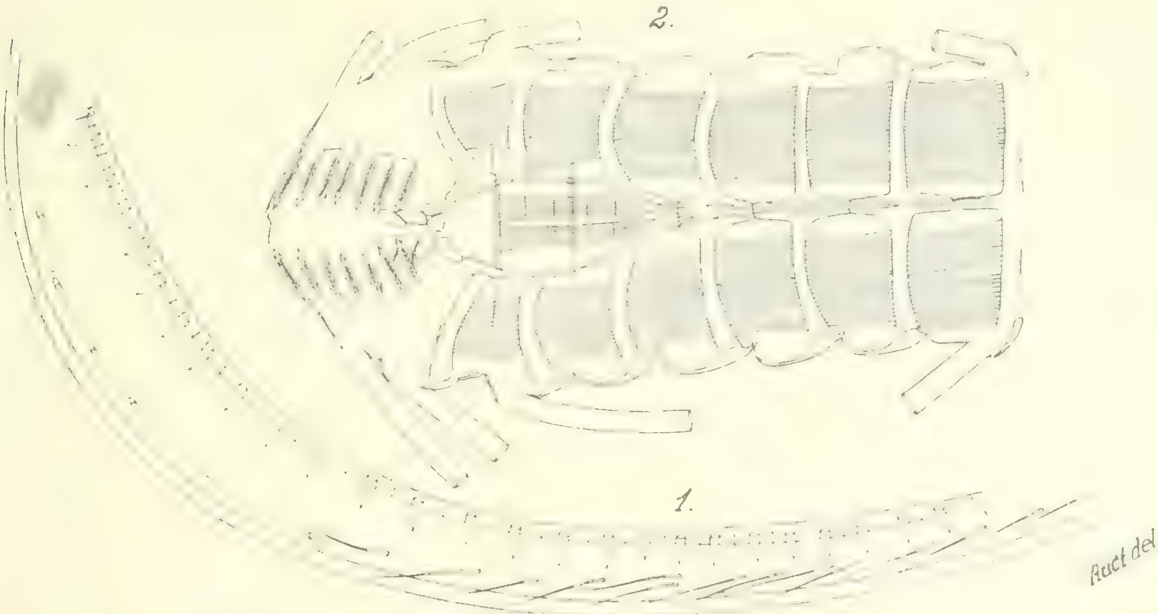

Fig. CI. — *Asterope Grimaldi* var. *arena* n. sp. et var. ♀. — 1. Left valve seen from inside, 186 ×. 2. Distal part of the seventh limb; the cleaning bristles are broken; 656 ×.

In order to decide the relation of *A. Grimaldi* and the variety described above to the above-mentioned forms and the mutual relations between the latter I shall try to give here a very much concentrated account and discussion of the descriptions and figures of the latter that are found in the literature.

The original description of W. BAIRD's *Cypridina Mariae* is found in this author's work of 1850 c, p. 257. This description is very short and incomplete and only deals with the appearance and length of the shell: „Carapace valves elongate oval, of exactly the same size at each extremity; extremities rounded. Dorsal and ventral margins nearly plane or very slightly arched". The shell is about 1.5 mm. long. It was found at the Isle of Skye Scotland. Three figures accompany this description, the shell as seen from the side, from above and from in front. The description and figures only show that this author had a mature female or a larva of a species probably belonging to the *Grimaldi* group of the genus *Asterope*.

Although it is quite impossible to identify a species of this group merely by the general shape and appearance of the shell, a fact that is clearly shown in this treatise, subsequent writers have, obviously without any re-examination of BAIRD's type-specimen, succeeded, as in the case of *A. teres* (A. M. NORMAN), not only in identifying forms investigated by themselves with this species of BAIRD's, but also in synonymizing with it forms described in a more or less unidentifiable manner by other writers and obviously not investigated by themselves. This can only be explained as being due to these writer's deficient knowledge of this genus.

Cypridina oblonga GRUBE, from the Adriatic Sea, has, according to the original description and figures, a shell that agrees very closely both in shape and length — 1,55 mm. — with W. BAIRD's *Cypridina Mariae*. The limbs and the furca of this species are described, but so incompletely that it is impossible to identify it with certainty, but still this form may, although hesitatingly, be referred to the same group of the genus *Asterope* as the form of BAIRD's has been with a reservation referred to above. Without going into details as to the peculiarities in GRUBE's description and figures that are obviously due to mistakes in observation on the part of this writer, the following characters that appear to distinguish this species may be mentioned here: The mandible has no bristles at all at the middle of the dorsal side of the basale. The sixth limb has only fifteen posterior ventral bristles. The seventh limb has eleven bristles, of which six are situated distally, three on each side, and five somewhat more proximally, four on one side and only one on the other.

G. S. BRADY's *Cylindroleberis Mariae*, 1868 b, which was found off Scotland and in the English Channel, differs exceedingly with regard to its shell from this species of BAIRD's: „Carapace as seen from the side, oblong-elliptical, more than twice as long as high, rather higher in front than behind." The shell is 2,3 mm. long. BRADY's description and figures of the limbs and the furca are very incomplete and obviously incorrect, so I shall not discuss them at any length here; although they thus do not permit of certain identification they clearly show that the species in question certainly belongs to the same group of the genus dealt with here as that to which the above forms of BAIRD's and GRUBE's have been referred. The difference in the shape of the shell from the former species is clearly due to the fact that BRADY has described and drawn a mature male while, as has been shown above, BAIRD had a mature female or a larva. The rather strongly marked dimorphism in the shape of the shell has not, if we are to judge from the text, been noticed by BRADY, a fact that did not, however, prevent this author from identifying the form examined by him with that of BAIRD.

G. O. SARS, 1887, states that the species *Asterope oblonga* (E. GRUBE) was found at four localities in the Mediterranean and in the Bay of Biscay*. Both the male and the female are described. This form certainly belongs to the *Grimaldi* group of this genus. The shape of the shell is that which is characteristic of this group. Length, 2,07 mm., ♂; 1,7 mm., ♀. Second antenna: The endopodite has a very short bristle distally on the second joint. Mandible: At about the middle of the dorsal side of the second protopodite joint there is a single bristle, which is about as long as the dorsal side of this joint. The exopodite is very

* I applied to Professor SARS for the specimens mentioned in order to re-examine them, but was informed that unfortunately they had all been lost beyond any hope of recovery.

small, about a quarter or a fifth of the anterior side of the first endopodite joint. The s i x t h l i m b has 24 posterior ventral bristles. T h e s e v e n t h l i m b has twelve cleaning bristles, six of which are concentrated distally, three on each side, and six scattered somewhat proximally of the former ones, three on each side.

G. S. BRADY and A. M. NORMAN's form *Asterope Mariae*, 1896, p. 630, is stated to have been taken at a number of places along the coasts of England and Scotland. The male and the female are described. The male seems undoubtedly to belong to the *Grimaldi* group. The female, on the other hand, can only be referred to this group with a certain amount of hesitation. F e m a l e: — S h e l l: Length 2,4 mm. The shape of the shell is the characteristic one for the *Grimaldi* group. S e c o n d a n t e n n a: The endopodite has one short bristle distally on the second joint. M a n d i b l e: At the middle of the dorsal side of the second protopodite joint there is a single bristle, which is about as long as the dorsal side of this joint. The exopodite is about half as long as the anterior side of the first endopodite joint. The second endopodite joint has a long narrow bristle between the main bristles b and c. M a l e: — S h e l l: Length? It is of the same type as is characteristic of this group. M a n d i b l e: The bristle situated at the middle of the dorsal side of the second protopodite joint is like that of the female. The exopodite is very short, only about a sixth or a seventh of the length of the anterior side of the first endopodite joint. The second endopodite joint has no long narrow bristle between the main bristles b and c. S i x t h l i m b: (With regard to this and the following limb the text does not explain whether the descriptions are based on male or female specimens). This has 25 posterior ventral bristles. S e v e n t h l i m b (according to the text, not according to the accompanying figure): The cleaning bristles are like those in the above-mentioned form described by G. O. SARS.*

It seems to follow from this review of these forms, which is perhaps too much condensed on account of space: 1) that E. GRUBE's species *Cypridina oblonga* cannot be considered as identical with *A. Grimaldi* and its variety or with any of the other forms discussed here, 2) that *A. Grimaldi* and its variety cannot be identified either with G. O. SARS' *Asterope oblonga*, 1887 or with *A. Mariae*, G. S. BRADY and A. M. NORMAN, 1896, 3) that the relation between the two latter forms cannot be decided with certainty; at any rate the females of these species cannot be considered as identical; the males, on the other hand, seem to be very closely related. 4) G. S. BRADY's species *Cylindroleberis Mariae*, 1868 b, must be considered unidentifiable.

With regard to G. W. MÜLLER's synonymization of *Copechaete elongata* and *C. affinis* I need only refer to the historical sketch of the genus, p. 434.

It is certain, if we are to judge from these authors' figures, that J. A. CUSHMAN's species *Cylindroleberis Mariae*, 1906, p. 366, *Cylindroleberis Mariae*, CH. JUDAY, 1907, p. 143 and *Cylindroleberis oblonga*, R. W. SHARPE, 1909, p. 423, all American forms, cannot be considered identical with any of the European forms dealt with above. With regard to CUSHMAN's species I may point out: F i r s t a n t e n n a of the female: The sensory bristle of the fifth joint has no sen-

* I may perhaps mention that I wrote to Professor G. S. BRADY to ask whether the type-specimen of BAIRD's species was in existence and whether he had examined it. He answered that he did not know whether it still existed and could not remember if he had investigated it.

sorial filaments. Mandible: The second protopodite joint has no bristles at the middle of the dorsal side. The exopodite is about half as long as the anterior side of the first endopodite joint. The second endopodite joint has two proximal bristles, which are almost as long as the main bristle a and one long, narrow bristle between the main bristles b and c. The end claw is about as long as the anterior side of the second and third endopodite joints. The furca has seven claws in the female (pl. 29, figs. 22, 24, 25). In the case of the two latter authors' forms a reference to the figures of the shell should be enough to support the contention I have put forward above; further details would be superfluous.

As neither descriptions nor figures have been given nothing can be said with certainty about the relation of the following forms to the forms treated above: *Cylindroleberis Mariae*, A. M. NORMAN, 1867, p. 198; 1869, pp. 259, 295. *Philomedes Mariae*, A. M. NORMAN, 1867, p. 208. *Asterope Mariae*, G. S. BRADY, 1871, p. 295; 1902 b, p. 99; G. O. SARS, 1872, p. 279; G. S. BRADY and D. ROBERTSON, 1872, pp. 59, 70; 1874, p. 115; 1876, p. 187; TH. SCOTT, 1902 b, pp. 497, 509, 511, 517; Marine Biological Association, 1904; C. H. OSTENFELD, 1906, p. 96; C. H. OSTENFELD and C. WESENBERG-LUND, 1909, p. 112; A. M. NORMAN and G. S. BRADY, 1909, p. 359. *Asterope oblonga*, E. GRAEFFE, 1900, p. 34. *Cylindroleberis oblonga*, G. W. MÜLLER, 1908, p. 94; O. de BUEN, 1916, p. 365.

In order still further to illustrate the uncertainty that exists with regard to the synonymization of forms belonging to this group the following facts may be added. I applied to Professor G. S. BRADY for specimens of *A. Mariae* so as to carry out a verificatory investigation. A tube containing a number of individuals, defined by Professor BRADY as *A. Mariae*, was kindly sent to me by this investigator. As will be seen in the remark under *A. aberrata*, p. 508 of this treatise, all the specimens except one turned out to belong to the latter species, which is of course a form that is fairly well differentiated from species of the *Grimaldi* group with regard to the type of shell, etc. The specimen that did not belong to *A. aberrata* was a larva, a male in the penultimate larval stage, which thus did not permit of certain identification of the species, but I do not hesitate, however, to state that it is very probable that it belonged to *A. norvegica*.

Since, as has been shown above, both *Cypridina Mariae* W. BAIRD and *C. oblonga* E. GRUBE are too incompletely described to allow of quite certain identification of these species, it seems undoubtedly best, at least for the present, to reject these two names of species in order to avoid further confusion. Only if it should turn out that fully identifiable type-specimens are still in existence or if only a single form of this type were to be found at the type localities, the Isle of Skye in the case of *C. Mariae* and Cherso Island in the Adriatic Sea in that of *C. oblonga*, ought these names to be adopted once more.

Habitat: — Mediterranean Sea: Villefranche-sur-mer, France, (type-locality); 19. I. 1916; depth 95 m.; fine clay; temperature at the bottom, + 13.5° C.; one mature female; (auctor coll.); R. M. S., on slides. Naples: one male juvenis (coll. G. W. MÜLLER); R. M. S., on slides.

Distribution: — Naples (G. W. MÜLLER, loc. cit.).

Asterope oculata G. S. Brady.

Asterope oculata (part.). G. S. Brady, 1902 a, p. 179, pl. XXI, figs. 6—13.

Description: — Male: —

Shell: — Length, 1,35—1,38 mm.; length : height about 1,78 : 1. Seen from the side (fig. 1) it is of about the same type as the shell of the male of *A. Grimaldi*, although, as will be seen from the figures given above, it is not inconsiderably higher relatively. Seen from below (fig. 2) it is also of about the same type as in the species mentioned. The wreath of hair round the posterior part of the shell is rather dense. Seen from inside: Medial bristles: There are a few bristles in the incisur, all scattered. About parallel to and somewhat inside the posterior margin of the shell there is a rather sparse but distinct row of stiff, moderately long bristles; this row of bristles, which becomes more and more sparse dorsally, extends all along the spine-bearing list (fig. 3). This list is gently undulated and has about 25—28 hyaline spines and numerous short bristles of somewhat different lengths, from 0 to about 7 bristles to each hyaline spine, somewhat fewer ventrally than they are dorsally. No broad or fine pores could be observed on the part between the spine-bearing list and the posterior margin of the shell.

First antenna: — This is very like this limb in *A. Grimaldi*. We must note: The longer of the two posterior distal bristles on the fourth joint is about as long as or rather slightly shorter than the total length of the three distal joints. The e- and f-bristles are subequal; they measured about 2,2—2,3 mm. in length, i. e. the same relative length as in the species mentioned above; the e-bristle has 25—26, the f-bristle 24 sensorial filaments.

Second antenna: — This is very like the corresponding limb in *A. Grimaldi*. A short bristle is developed on the protopodite distally medially close to the exopodite. Endopodite: The second joint has no verruciform swelling close to the three bristles. The end joint is undulated on the outside (the ventral side) just distally of the proximal bristle in about the same way as is shown in G. S. Brady's drawing. Both the specimens investigated by me had this undulation; G. S. Brady in his original description, p. 180, states, however, that this character is not constant. The proximal bristle on this joint is longer than is shown in G. S. Brady's drawing; I was unable to decide how long, as it was broken in both the specimens investigated.

Mandible: — Protopodite: Coxale: The scythe-shaped process (fig. 4): The part distally of the main spine grows evenly and rapidly narrower to a fine point; its ventral edge is straight or slightly concave with a distinct corner near the main spine; this corner is not always, however, so sharp as in the adjoining figure. The distance from the point of the process to the main spine is very much less than the distance from the latter to the proximal ventral spine. The dorsal bristle is fixed somewhat nearer the main spine than the point of the process or is about equidistant from both and is fixed slightly distally of the main spine. The dorsal serrate teeth are rather weak. The main spine is also rather weak and has a weakly developed ridge of hairs. There are four rather powerful ventral spines and in addition three or four weaker ones, one between the third and fourth spines and three distally of the fourth. On

the part distally of the main spine there are only one or two transverse rows of hairs. The rod-shaped process has three short, powerful spines distally. Basale: The backward pointing process has four distal bristles, four triaena bristles and two dwarf bristles. The anterior of the triaena bristles was short and weak with very weak secondary teeth, the others were of the same type as in other species in this group, i. e. with relatively few (from two to five pairs?) of secondary spines under the distal pair of spines. The glands of the process issue on an almost completely

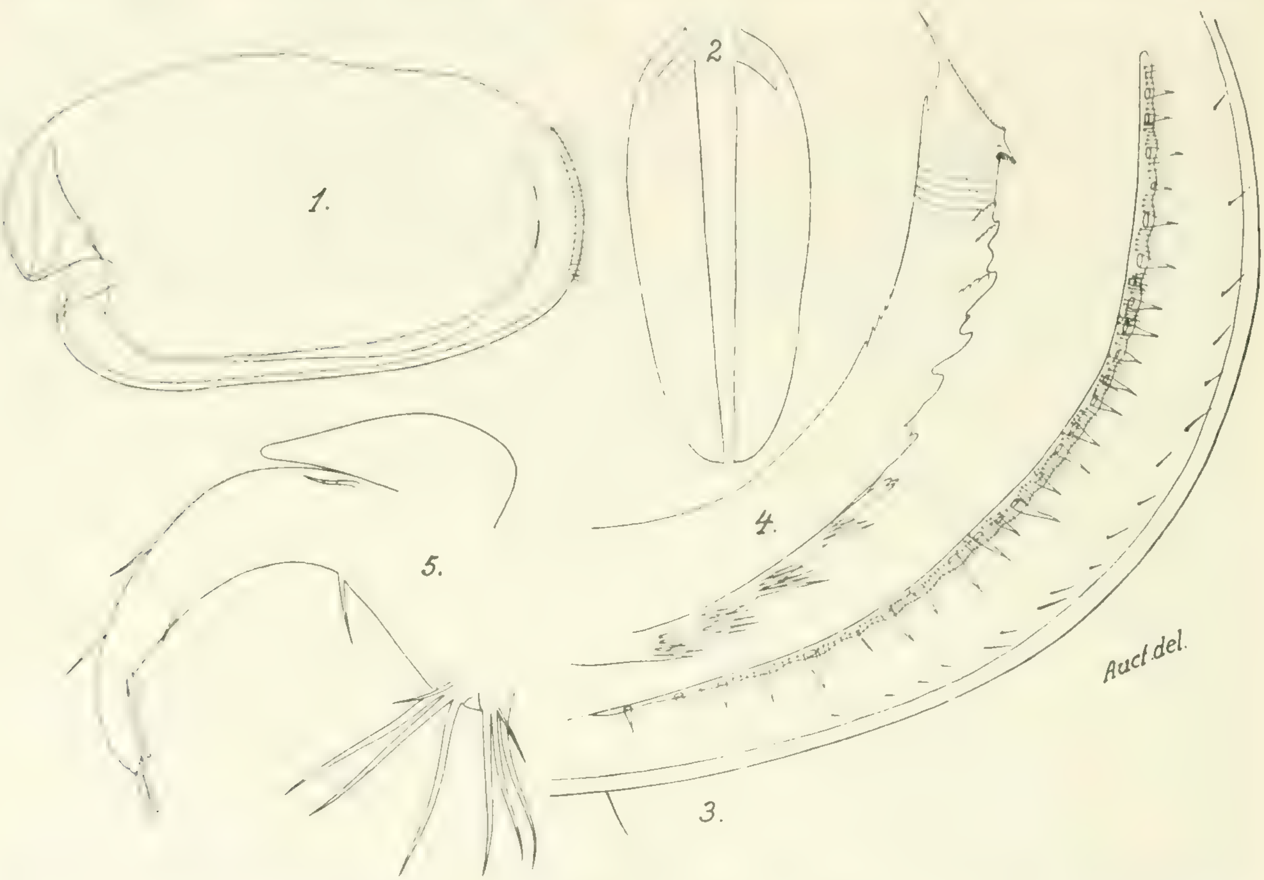

Fig. CII. *Asterope oculata* G. S. Brady, ♂. — 1. Shell seen from the side; 56 ×. 2. Shell seen from below; 42 ×. 3. Posterior part of the right valve seen from inside; 188 ×. 4. Endite on the coxale of the mandible; 480 ×. 5. Right maxilla seen from inside; 256 ×.

reduced verruca. Somewhat in front of the middle of the dorsal side of this joint there is a single bristle, which is somewhat shorter than the dorsal side of this joint; apart from this there are no hairs or bristles on the middle of the dorsal side of this joint. One of the two dorso-distal bristles on this joint is unusually short, scarcely half as long as the anterior side of the first endopodite joint. The e x o p o d i t e is comparatively large; if its end bristles are included, it is about as long as the anterior side of the first endopodite joint. E n d o p o d i t e: The first joint is not armed anteriorly with chitinous spines. The second joint has at least two proximal bristles; their length I was not able to observe. No long, narrow bristle, with short hairs, between the main bristles b and c. The cleaning bristles are comparatively few in number;

five or six were observed in a distinct lower row and one near the main bristle b. The end claw is strong, but rather short; it is about as long as the anterior side of the second endopodite joint to the main bristle c.

M a x i l l a (fig. 5): — P r o t o p o d i t e: Contrary to what is the case in all the other known species of this genus, the distal endite, like the proximal one, is armed with four bristles, three rather long, subequal ones and one quite short one. The dorso-proximal bristle is rather short. There is one moderately long ventral bristle and two subequal dorso-distal bristles, which are about as long as the dorso-proximal bristle; one of these is situated somewhat proximally of the other. (The dorso-distal bristles were found on only one of the two specimens investigated; the other was defective in this character.) The short ventero-distal bristle is developed.

S i x t h l i m b: — This is of the same type as in *A. Grimaldi*; I was unable to ascertain exactly the number of ventral bristles, but it is probably about the same as in the above-mentioned species.

T h e s e v e n t h l i m b is of the same type as that of *A. Grimaldi*.

The f u r c a has eight (nine?) claws, of which the six anterior ones may be denoted as main claws; they are of about the same type as is reproduced for the female of *A. Grimaldi*, i. e. with a moderately strong bend on the anterior claws. The two anterior claws have no ventero-proximal spines. The two posterior ones, the secondary claws, are annulated. The equipment of all these claws is the typical one for males of this genus.

Remarks: — The description given above is based on investigations of two specimens from Trincomalee, Ceylon, which were kindly placed at my disposal by the Z o o l o g i c a l M u s e u m o f C o p e n h a g e n and which were termed type specimens by Professor G. S. BRADY. Unfortunately, however, the description is, as is seen, very incomplete; this is due to the exceedingly bad condition of the specimens — mixed with dirt, breaking easily and with many of their bristles broken. Still I hope that this re-description has made the systematic position of this species more certain. *Material.*

The direct deviations from G. S. BRADY's original description that occur are probably due to the exceedingly superficial method of investigation employed by this writer. I may mention here: S h e l l: „antennal notch rather wide and shallow", „posterior extremity . . . . bearing two fascicles of hairs, one near the dorsal, the other near the ventral end". M a n d i b l e: „there is no toothed process on the basal joint". F u r c a: the absence of „distinct pectinated armature" on the claws. *Differences from the original description.*

As is seen above, I have written *A. oculata* G. S. BRADY (part.) as a synonym of this species. The reason for this is that there did not seem to be sufficient reasons for grouping the female described by G. S. BRADY 1902 a, p. 180 under this name together with the male discussed above. *Synonymy.*

So far in the literature there is only one statement to the effect that mature males of this genus have been reared from larvae in aquariums, namely G. W. MÜLLER's statement, 1894, p. 13, about *A. oblonga* (E. GRUBE). As the male in the last larval stage is very like the mature female, there seems to be no doubt that the male larvae with which G. W. MÜLLER experimented

really belonged to the female mentioned by this author. By means of these experiments it was found that the mature males of this species have almost the same type of shell as the female; the male shell differs from that of the female almost only by being somewhat lower posteriorly. I have obtained much the same result in the case of two other species belonging to the same group of forms as *A. oblonga*, namely *A. Grimaldi* and *A. norvegica*. There can scarcely be any doubt that the males and females which have been grouped together in these two cases really belong to the same species. The great anatomical resemblances are quite a decided argument for this. In the case of *A. Grimaldi* this grouping is confirmed still further by the fact that this male and female were found together at one locality, where I ascertained by a large number of dredgings that there were no other males and females of this genus present.

With regard to the type of shell in the males of females that have short, pear-shaped shells we know practically nothing from the literature that has appeared up to now. G. S. BRADY and A. M. NORMAN mention, however, 1896, p. 638, that they had found the male of *A. teres* (A. M. NORMAN). No description of this male's shell is given, but the text seems to show that it was of the same short, pear-shaped type as that of the female. These authors write: „We are unable to say in what slight respects the shell of the male differs from that of the female." Believing it was a female, they had dissected the specimen before investigating the shell more closely. — I cannot of course say with absolute certainty whether the male and the female that I have grouped together in this work under the name of *A. curta* are really the male and female of the same species. There are, however, strong arguments in favour of the correctness of this grouping: cf. p. 503. If this grouping is correct, there is thus only rather weak dimorphism with regard to the shell present in this group of forms as well.

As both males and females of both the elongated and the short type exist, it seems as if a grouping of males of the one type with females of the other as males and females of the same species would at any rate necessitate clearer proof than that put forward by G. S. BRADY in the case of *A. oculata*.* The only argument that seems to support this writer's assumption is that the two forms were found in the same sample. „One female only could be found, and this occurred with only one or two males", etc. It was thus not a large number of males and females that were caught together, but only one female and „one or two" males. This naturally makes this argument of no value. — Unfortunately this female did not exist in the collection that was sent to me from the Copenhagen Zoological Museum. It is presumably altogether lost. I am thus unable to confirm or reject the assumption put forward by G. S. BRADY by making an anatomical investigation.

As has been shown at another place of this treatise, p. 490, G. W. MÜLLER synonymizes *A. oculata* with *A. teres* (A. M. NORMAN). Whether the female referred by G. S. BRADY to this species is identical with this species of NORMAN's cannot at present be decided with certainty. It does not seem probable to me. As is shown above, there seems to be still less reason for assuming that *A. oculata*, ♂ is identical with *A. teres*.

In spite of the incompleteness and uncertainty of the original description of this species two subsequent authors have succeeded, all the same, in identifying with it forms investigated

* Compare p. 490 above, G. O. SARS's explanation of *A. teres* and *A. Mariae* as female and male of the same species.

by them. A. SCOTT, 1905, p. 366, states that this species was found at a number of stations in Ceylon; a total of ten females and four males is stated to have been caught. No figures are given, so that I did not think it proper to include this form as a synonym. TH. SCOTT, 1912 a, p. 586, gives this species as coming from Gough Island, lat. 40° 20′ S., long. 9° 56′ W. Two figures which are quite useless for certain identification are given, but no description. This cannot possibly be included as a synonym.

Nothing definite can be said as to the relation of my species *A. Mülleri*, *Ohlini* and *curta* to the female referred by G. S. BRADY to *A. oculata.*

Distribution: — Ceylon: Trincomalee (G. S. BRADY, 1902 a). Whether it also occurs at St. Johns (Cruz Bay), Lesser Antilles, I cannot say; it seems rather probably, however, that this identification of G. S. BRADY's is due to a mistake.

Type specimen of the re-description on slides in the collections of the K. Z. M.

Asterope norvegica G. O. SARS.

Asterope norvegica, G. O. SARS, 1869, p. 357.
„ „ G. S. BRADY and A. M. NORMAN, 1896, p. 635; pl. LII., figs. 7—9.
„ „ G. W. MÜLLER, 1912, p. 45.

Description: — Female: —

Shell: — Length, 2,0—2,26 mm.; length : height about 1,9 : 1; length : breadth about 2,2 : 1. Seen from the side (fig. 1) it is of about the same type as *A. Grimaldi*, but, as is shown by the figures given above, it is somewhat higher relatively. The dorsal and ventral margins are somewhat, though only rather slightly, more decidedly curved than in the species mentioned above. Seen from below (fig. 2) it also has about the same type as *A. Grimaldi*; it is only a little broader relatively. Seen from inside: Medial bristles: On the rostrum there are rather numerous, stiff, moderately long bristles; of these the ones that are situated nearest to the anterior margin of the shell are arranged in a rather dense and distinct row running somewhat inside and about parallel to the margin of the shell; the others are scattered. Most of these bristles are subequal, those situated along the anterior margin of the shell are perhaps on the average rather shorter than the rest; among the latter, however, a few more or less short bristles are interspersed, especially among those situated farthest in. On the anterior wall of the incisur there are rather numerous scattered moderately long bristles, most of them subequal. There is in addition in the incisur a very dense row of similar bristles, running about parallel to and somewhat inside the ventral margin of the rostrum. Besides these bristles there are in the incisur only a few moderately long scattered bristles. On the part just behind the incisur there are also rather numerous scattered bristles; most of these are of about the same type and length as the long bristles on the rostrum, a number of those situated farthest in are very short; on the anterior portion of this part there is often only a very small number of bristles situated farthest in; these are all extremely short. Along the ventral margin of the

shell there is a moderate number of rather short bristles, arranged in a single distinct row. Posteriorly, somewhat in front of the spine-bearing list, this row becomes very dense and at the same time the bristles become longer and coarser; it continues up along the ventral quarter or third of the spine-bearing list, running about half way between the latter and the margin of the shell (fig. 5). The spine-bearing list has rather few hyaline spines, about 19—20, of somewhat varying size, and has a sparse row of short bristles, about one or two between each hyaline spine. The double line drawn in fig. 5 inside the posterior margin of the shell corresponds to a sharp ridge; the part of the shell between this ridge and the posterior margin of the shell is situated rather considerably laterally — i. e., when the shell is looked at from inside, it is considerably deeper — of the part between the ridge and the spine-bearing list; a ridge of this sort is characteristic for both the valves. Just inside the dorsal half of this ridge there is a sparse row of broad pores (six such pores were always observed on the specimens investigated); in the specimens investigated these pores did not seem to be furnished with low hyaline pegs. In addition a rather dense and irregular row of fine pores issues near this ridge.

F i r s t a n t e n n a (figs. 6 and 7): — This is very like the corresponding limb in *A. Grimaldi.* We may note: It is seven-jointed, the third and fourth joints are not united to each other. Of the six anterior bristles on the third joint no. 5 has short hairs. The a-claw on the end joint is only slightly longer than the anterior side of the fifth and sixth joints; it has only extremely weak pectination dorso-proximally. The f-bristle has five, the e- and g-bristles six or seven sensorial filaments. The first and second joints are rather abundantly furnished with hairs; the second joint, however, as in *A. Grimaldi*, has no row of hairs along the distal boundary.

S e c o n d a n t e n n a (fig. 9): — Very like that of *A. Grimaldi.* The p r o t o p o d i t e has a short bristle disto-medially close to the exopodite. E n d o p o d i t e: On one specimen this was abnormally developed on one side, reminding one very much of this branch in the male in the penultimate larval stage; the second joint had a very small bristle near its distal boundary; the bristle of the end joint was displaced somewhat proximally (fig. 10).

M a n d i b l e (fig. 11): — P r o t o p o d i t e: Coxale: The scythe-shaped process (fig. 12): The part situated distally of the main spine grows narrow rather rapidly, but not so rapidly as in *A. Grimaldi.* into a fine point; its ventral edge is slightly concave distally and slightly convex or almost straight proximally; it forms, just near the main spine, a rather weak spine which points proximally. The distance between the point of the process and the main spine is rather slightly shorter than the distance from the latter to the proximal ventral spine. The dorsal bristle is fixed somewhat nearer the main spine than its distance from the point of the process, and somewhat, though only rather slightly, distally of the main spine; it extends rather slightly beyond the point of the process. The dorsal serrate teeth are rather few in number, but comparatively large. The main spine is rather strong. There are four ventral spines, the two distal ones of which are rather weak, the two proximal ones rather strong. Between the distal ventral spine and the main spine the ventral edge is finely serrated; the serrate teeth point proximally; this serration may sometimes be more or less completely missing — presumably on account of wear. On the part distally of the main spine there are only a few — two or three were observed — transverse rows of hairs. The rod-shaped

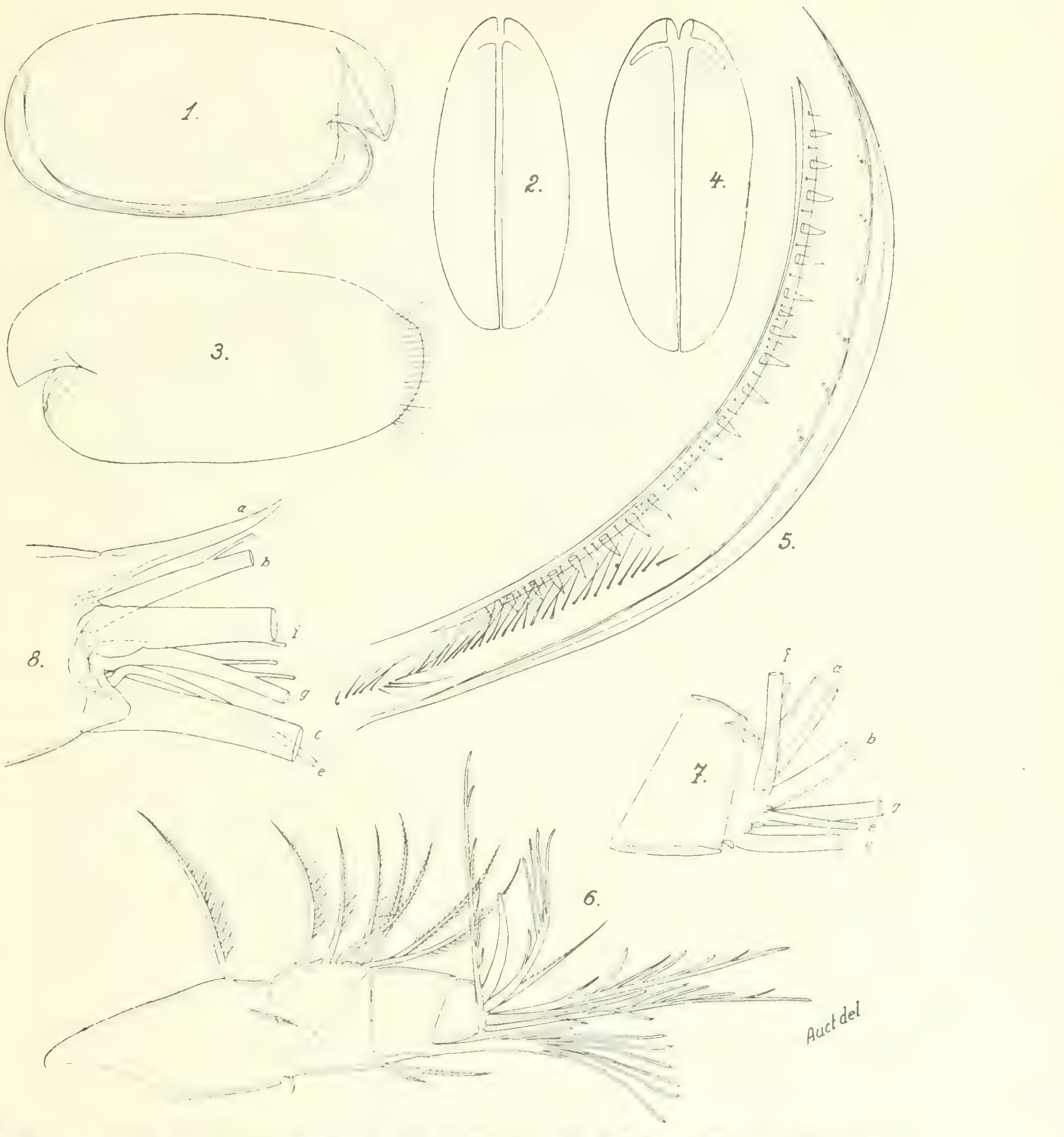

Fig. CIII. — *Asterope norvegica* G. O. SARS. — 1. Shell seen from the side, ♀: 33 ×. 2. Shell seen from below, ♀: 25 ×. 3. Shell seen from the side, ♂: 32 ×. 4. Shell seen from below, ♂: 25 ×. 5. Posterior part of the right valve seen from inside, ♀: 160 ×. 6. Right first antenna seen from outside, ♀: 125 ×. 7. Distal part of this antenna seen from the same side; all the bristles are broken, ♀: 312 ×. 8. Distal part of this antenna seen from the same side; all the bristles except the a-claw are broken, ♂: 312 ×. Figs. 1—5 are drawn from a specimen determined by Professor G. O. SARS.

process has three short, strong bristles distally. Basale: The backward pointing process has four distal bristles, three or four triaena bristles and two dwarf bristles. The triaena bristles have from two to five pairs of secondary spines beneath the distal pair of spines. The glands issue on an almost entirely reduced peg. At about the middle of the dorsal side of this joint there is a single bristle, which is about half as long as the dorsal side of this joint; this bristle has short, fine hairs distally. On the outside of this joint there are also groups of short, stiff hairs dorsally, some of which, at least, are rather coarse. The e x o p o d i t e is, if its two distal bristles are included, somewhat more than two thirds of the length of the anterior side of the first endopodite joint. E n d o p o d i t e: First joint: The shortest of the three ventral bristles has only short secondary bristles. The longest of these bristles is armed with about nine short secondary bristles proximally of the long secondary bristles; the next longest of these bristles has no such short proximal secondary bristles. This joint has no spines antero-distally. The second joint has one proximal bristle, which is about a third of the length of the main bristle a. Proximally of this proxinal bristle there is a group of short, fine hairs. Between the main bristles b and c there is no long, narrow bristle with short hairs. The medial cleaning bristles are rather numerous, varying somewhat in number (fig. 13); three specimens that were investigated showed the following conditions:

SARS's specimen.	Right mandible	6 bristles in a distinct lower row. 4 „ „ „ „ upper „ 1 bristle close to the main bristle b. 1 „ between the main bristles a and b
	Left „	6 bristles in a distinct lower row. 1 bristle above bristles nos. 5 and 6 in this row. 3 bristles in a distinct upper row. 2 „ near the main bristle b. 1 bristle between the main bristles a and b.
Specimen 2 (from Bohuslän).	Right and left mandibles	7 bristles in a distinct lower row. 4 „ „ „ „ upper „ 2 „ near the main bristle b. 1 bristle between the main bristles a and b.
Specimen 3 (from Bohuslän).	Right and left mandibles	7 bristles in a distinct lower row. 4 „ „ „ „ upper „ 1 bristle near the main bristle b. 1 „ between the main bristles a and b.

The end claw is somewhat longer relatively than in *A. Grimaldi*, about as long as or slightly longer than the anterior side of the first endopodite joint; it is smooth.

M a x i l l a (fig. 14): — P r o t o p o d i t e: The distal endite is armed with three subequal bristles. The dorso-proximal bristle is relatively short. The basale has one ventral bristle of moderate length and a series of five subequal dorso-distal bristles, which are in most cases somewhat shorter than the ventral bristle. The short ventero-distal bristle is developed.

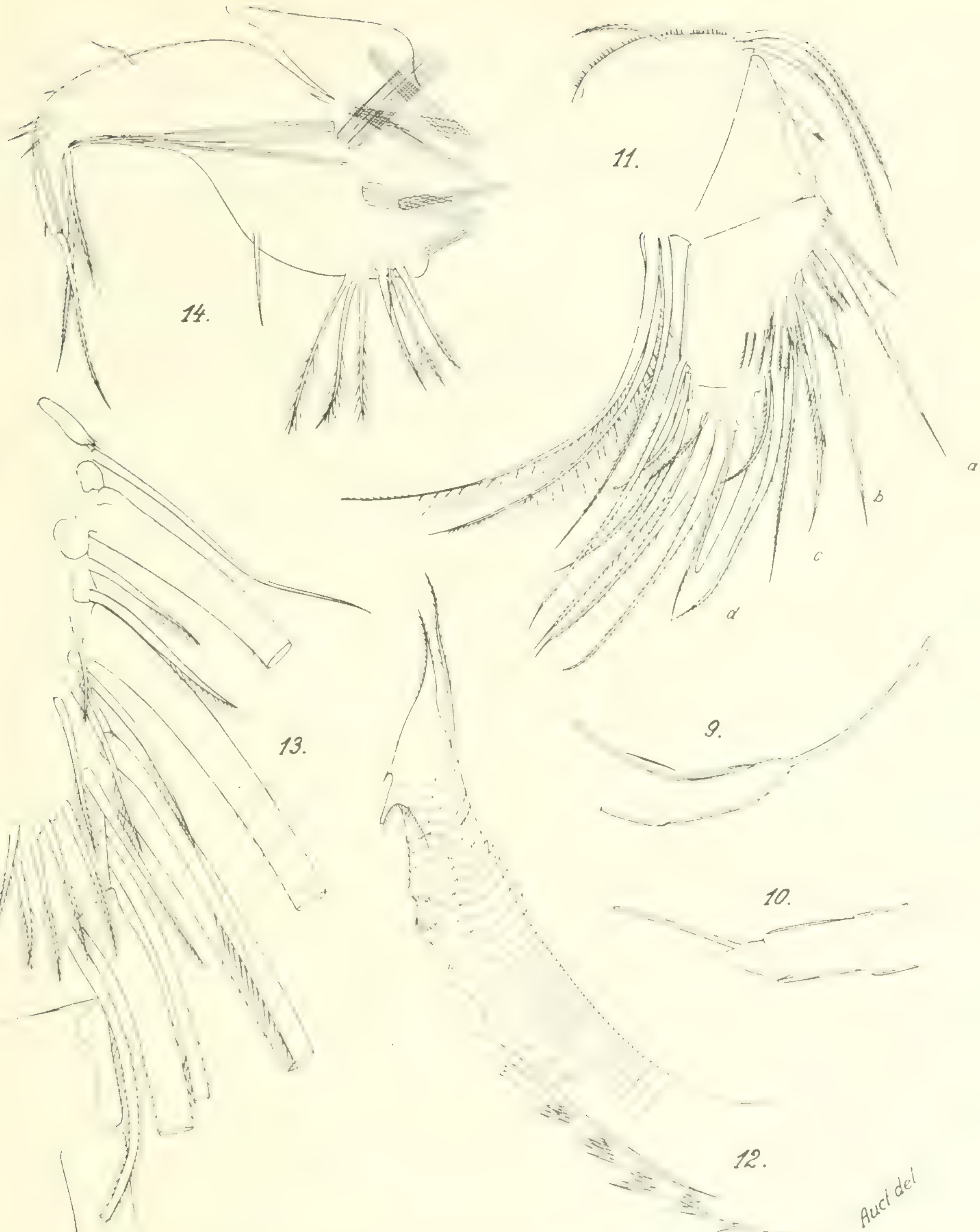

Fig. CIV. — *Asterope norvegica* G. O. Sars. ♀. — 9 and 10. Endopodite of the second antenna; no. 10 is abnormal. 248 ×. 11. Left mandible seen from inside. 160 ×. 12. Endite on the coxale of this limb. 480 ×. 13. Anterior part of the two distal endopodite joints of the left mandible seen from inside, all the long bristles are broken. 480 ×. 14. Right maxilla seen from inside. 160 ×. Figs. 11, 13 and 14 are drawn from a specimen determined by Professor G. O. Sars; the cleaning bristles on fig. 11 are, however, drawn from another specimen.

Endopodite: The posterior distal bristle on the first joint is somewhat shorter than the bristle on the end joint.

Sixth limb: — The posterior edge is fairly straight or sometimes even slightly concave, but the posterior ventral corner is rather broadly rounded. There are 22—24 posterior and seven anterior ventral bristles. Two bristles are developed on the anterior edge of the limb.

Seventh limb: — Very like the corresponding limb in *A. Grimaldi*. In exceptional cases it has only eleven cleaning bristles.

The furca is armed with ten claws, of which the seven or eight distal ones may be termed main claws. The two anterior main claws are equipped with ventral spines right to their bases, the proximal ones of these spines are, however, of the same type as those situated more distally. The two posterior secondary claws are annulated.

The lateral eyes are well developed. The median eye is bare.

Male: —

Shell: — Length, 2.42 mm.; length : height about 2 : 1; length to breadth about 2.25 : 1. Seen from the side (fig. 3) it is of about the same type as that of the male of *A. Grimaldi*, but, as is shown by the figures given above, it is somewhat higher relatively. The anterior and posterior arcuations of the dorsal margin are somewhat more defined. The part beneath the incisur dominates somewhat over the part above it. The posterior part of the shell is cut off rather abruptly, the posterior margin is rather slightly rounded, the posterior dorsal corner is somewhat more distinct than in *A. Grimaldi*. Seen from below (fig. 4) it is of the same type as in the species just mentioned. The wreath of hairs round the posterior part of the shell is rather dense. Seen from inside: Medial bristles: These are much the same as in the female, but somewhat more sparse; the short bristles that are interspersed among the longer bristles seem to be considerably more numerous, compared with the latter than in the female. Apart from this the shells of the two sexes are alike.

First antenna (fig. 8): — For the proportions between the joints see the description of the genus. This antenna is very like that of *A. Grimaldi*; cf. fig. 11 of this species. We may note: Of the six anterior bristles on the third joint no. 5, like this bristle in the above-mentioned male, but contrary to the female, is armed with long, stiff secondary bristles arranged fairly well on all sides. The a-claw is finely pectinated and is somewhat shorter than the anterior side of the sixth joint. The e- and f-bristles are subequal and about $1\frac{1}{3}$ times as long as the shell (3.3 to 3.5 mm. was observed); 33—34 sensorial filaments were observed on the e-bristle, 31—32 on the f-bristle.

Second antenna: — The exopodite is considerably longer than in the female, the two proximal joints especially being very much lengthened. The proportion between the joints is shown by the following figures:

♂ (shell 2,42 mm. long) = I : II : (III—IX) = 47 : 16 : 26.

For the sake of comparison the corresponding figures (measured on the same scale) for the female second antenna may be given:

♀ (shell about 2,2 mm. long) = I : II : (III—IX) = 29 : 6 : 21.

The second joint is about as long as the four or five following joints together. The third to the ninth joints are about the same length, as is the case in the female. The fourth to the ninth joints have extremely weak, scarcely perceptible, basal spines. Endopodite: The three bristles on the second joint have rounded points, furnished with a very short distal sensory hair. The longest of these bristles is somewhat longer than the breadth of the joint at the point where the bristle is attached; the shortest is only about a seventh of the length of this bristle. The end joint is very much flattened and has hyaline side borders. On the inside at its point it is provided with a few weak transverse chitin lists. Its proximal bristle is at least a third of the length of this joint (broken).

Mandible: — Protopodite: Basale: The backward pointing process has the same number of bristles as in the female. Of these bristles the distal end bristle and the dwarf bristles are practically the same size as the corresponding bristles in the female. The distal end bristle is, at least towards its point, armed with rather strong secondary spines. The three other end bristles and the triaena bristles are, it is true, practically the same length as the corresponding bristles in the female, but they are very weak and have very weak armature; the main pair of secondary spines on the triaena bristles can scarcely be distinguished from the proximal secondary spines, which are almost like hairs. The bristle on the middle of the dorsal side of this joint is perhaps somewhat longer than the corresponding bristle in the female. The dorsal side of this joint is, apart from this, quite smooth without any of the hairs and spines that characterize the female. Endopodite: First joint: Of the three ventral bristles the shortest one is armed at the middle with numerous rather fine, long secondary bristles placed on all sides; distally it has short hairs. The two others have no short secondary bristles proximally of the long ones. Second joint: This has three proximal bristles differing somewhat in length, the longest not half the length of the main bristle a. The medial cleaning bristles showed the following numbers and arrangement on the specimen investigated:

Right mandible	7 bristles in a distinct lower row.
	4 ,, ,, ,, ,, upper ,,
	2 ,, near the main bristle b.
	1 bristle between the main bristles a and b.
Left mandible	7 bristles in a distinct lower row.
	5 ,, ,, ,, ,, upper ,,
	3 ,, near the main bristle b.
	1 bristle between the main bristles a and b.

These bristles were somewhat longer than the corresponding ones in the female, but, on the other hand, they were somewhat more weakly armed than these. The end claw was like that of the female.

Seventh limb: — The cleaning bristles were armed with from two to four bells.

The furca had nine or ten claws, of which the six or seven anterior ones may be termed main claws. The anterior main claws are somewhat more decidedly bent than in the female

(about the same as in the male of *A. curta*) and have no proximal spines. The two or three posterior claws are annulated.

The lateral eyes are somewhat larger than those of the female.

Remarks: — This species was introduced into the literature by G. O. SARS, 1869, p. 357. Although the original description is very deficient and is not illustrated by any figures, it has, all the same, seemed possible to succeeding writers who have dealt with these questions to identify it. Even G. W. MÜLLER includes it, 1912, p. 45 as identifiable. This author writes about this species (l. c.): „Der *A. abyssicola* sehr ähnlich, wenig gestreckter. 3. Thoraxbein mit 10 Borsten. Furca mit 5 Dornen, denen noch 2 Borsten folgen. Größe ♂ und ♀ 1,34 mm."

The comparatively small number of cleaning bristles on the seventh limb and of claws on the furca and the small length of the shell made me begin to suspect that G. O. SARS had based his description on a specimen that was not yet mature. This suspicion seemed, however, to be directly contradicted by the fact that G. S. BRADY and A. M. NORMAN, who, to judge from the figures of the shell that they add, had mature specimens to investigate — „specimens for which we are indebted to Professor SARS" — gave the same length of shell in their work of 1896 as G. O. SARS had given and merely quote SARS's description for other characters. On the other hand this suspicion was confirmed still more strongly by a statement of G. O. SARS himself, as this author writes, 1887, p. 31 (203): „Naervaerende Art" (= *A. oblonga*, length ♀ 1,7 mm., ♂ 2,07 mm.) „upnaar saaledes gjennemgaaende en betydeligere Størrelse end foregaaende, skjøndt den i denne Henseende staar adskilligt tilbage for den nordiske Art *A. norvegica*."*

In order to decide this point I wrote to Professor SARS asking if it was possible to re-investigate the type specimen of this species. In reply to this question Prof. SARS communicated to me that unfortunately it was quite certain that this specimen was lost, but he sent me at the same time two specimens, a mature female and a mature male, which he had determined as specimens of *A. norvegica*. I could not of course decide with absolute certainty whether this identification of Prof. SARS's was correct; as, however, the original description does not seem directly to contradict it, I have accepted it.

The result of the investigation of these specimens is given in the re-description of the species given above. As is seen best from a comparison between SARS's original description and my new description, it fully confirmed my suspicion that the type specimen had not been mature.

It does not seem impossible, however, that the specimens investigated by me are the same as were previously investigated by G. S. BRADY and A. M. NORMAN, on which they based their information in their work of 1896. In this case it is a good illustration of these investigators' methods of work.

As will be seen from a remark under *A. aberrata* I had sent me a specimen caught in Strangford Lough, Ireland, which was defined by Prof. G. S. BRADY as *A. Mariae* (W. BAIRD) and which after a careful investigation proved to be a male in the penultimate larval stage,

* „The present species thus always attains a considerably greater size than the preceding one, although its dimensions are considerably smaller than the Scandinavian species *A. norvegica*."

very probably belonging to *A. norvegica.* — On account, however, of the difficulty in defining with certainty the species of larvae belonging to this genus, it did not seem convenient to me to include this locality among the new habitats given below, especially as this species is not previously know from this region. The specimen had a shell 1,72 mm. long.

Habitat: — West coast of Sweden: Bohuslän: E. N. E. of Stora Sneholmen. Koster; 18. V. 1897; depth down to 160 m.; clay:one juvenis; (coll. J. G. ANDERSSON); R. M. S. 184. N. E. of this island; 26. V. 1897; depth 160 m.; clay: one juvenis; (coll. J. G. ANDERSSON); R. M. S. 185. Väderöarna; depth 70—100 m.; coral bottom: one juvenis; (coll. v. GOËS); R. M. S. 186. Gullmar Fjord, no definite locality, probably at Skår; depth 90—110 m.; clay: 5 mature females and 4 juvenes; (coll. S. LOVÉN); R. M. S. 187. Gullmar Fjord, Fiskebäckskil; 16. VII. 1894; clay: 3 mature females; (coll. J. G. ANDERSSON); R. M. S. 188.

On the label of the two specimens that I got from G. O. SARS, no locality was to be found; the specimens in question were, however, certainly from the coast of Norway.

Distribution: — Christiania Fjord, Holmestrand, type-locality, depth 90—110 m.

Asterope abyssicola G. O. SARS.

Asterope abyssicola, G. O. SARS, 1870, p. 170.
.. .. 1886, p. 74.
.. .. G. S. BRADY and A. M. NORMAN, 1896, p. 636, pl. LII, figs. 18, 19.
.. .. G. W. MÜLLER, 1912, p. 45.

Description: — Female:

Shell: — Length 1,63 mm.; length : height about 1,92 : 1; length : breadth about 2,17 : 1. Seen from the side (fig. 1) it is elongated, with its greatest height at about the middle and the anterior part somewhat, though only very slightly, larger than the posterior part. The dorsal and ventral margins are almost parallel to each other and are rather weakly, uniformly and almost equally curved; anteriorly they are somewhat flattened; they pass evenly into the anterior and posterior margins. The anterior and posterior margins are evenly and boldly rounded, the former being almost semi-circular, the latter somewhat more weakly curved ventrally than it is dorsally. Seen from beneath (fig. 2) it has its greatest breadth at about the middle and grows narrow rather rapidly towards the ends, somewhat more rapidly forward. The anterior end is rounded, the posterior end somewhat heart-shaped; the side contours are even. Seen from inside: Medial bristles: (On account of the condition of the specimen investigated the information given about these bristles is perhaps not quite so certain as might be desired.) On the rostrum there is a rather distinct, relatively sparse row of moderately long bristles which runs about parallel to and somewhat inside the anterior margin of the shell. Inside this row of bristles there is only a rather small number of bristles scattered on the rostrum, some moderately long and some very short. On the anterior wall

of the incisur there is a moderate number of scattered and moderately long bristles. Besides these bristles there are only a rather few moderately long bristles in the incisur, most of which are scattered, some perhaps with a faint indication of being arranged in a row running somewhat inside and about parallel to the ventral margin of the rostrum. On the part just behind the incisur there are also only sparse medial bristles, of which those situated nearest the margin of the shell are moderately long and are arranged in a sparse row running about parallel to and somewhat inside the margin of the shell; those situated farther in are short and scattered. Along the middle of the ventral margin of the shell there is a not inconsiderable number of rather short bristles, arranged in a rather distinct row running about parallel to and somewhat inside the margin of the shell. Along the posterior part of the ventral margin there are only single short bristles. At about half way between and running parallel to the ventral quarter or third of the spine-bearing list and the margin of the shell there is a sparse row of moderately long bristles. The spine-bearing list has 21—22 hyaline spines; in addition there are a moderate number of short bristles, in most cases two or three between the dorsal spines, one or two between the ventral ones. Between the spine-bearing list and the posterior margin of the shell there is a ridge similar to that in *A. norvegica* and close to this ridge there are also broad and fine pores such as are to be found in this species.

First antenna (fig. 3): — This is very like that of *A. Grimaldi.* It is to be noted: The original third and fourth joints form together a joint that is somewhat, though only slightly, shorter than it is high and also somewhat shorter than the total length of the original fifth and sixth joints. The anterior bristle of the second joint is about as long as or rather slightly longer than the anterior side of this joint. In the specimen investigated the original third joint had on the anterior side five bristles on the right, four bristles on the left antenna (one or two bristles respectively broken off?). Of these bristles nos. 2 and 4 were unusually short, only about half as long as no. 1. The stem of the sensory bristle of the fifth joint relatively short, only about as long as the total length of the two penultimate joints; with seven sensorial filaments. The number of sensorial filaments on the e-, f- and g-bristles could not be decided on account of the defective condition of these bristles. Pilosity: The first and second joints have abundant groups of short, fine, stiff hairs (only indicated in the accompanying figure), but there are no hairs along the distal boundary of the second joint. There is a series of short hairs anteriorly on the distal boundary of the (original) fifth joint.

Second antenna: — Distally-medially close to the exopodite there is a short bristle on the protopodite. The exopodite has no basal spines at all. The endopodite is weakly three-jointed; its end bristle is almost twice as long as the stem (about 14 : 7,5).

Mandible (fig. 4): — Protopodite: Coxale: The scythe-shaped process (fig. 5): The part distally of the main spine narrows evenly and gently into a fine point; its ventral edge is uniformly and weakly convex, almost straight. The distance from the point of the process to the main spine is somewhat greater than the distance from the latter to the proximal ventral spine. The dorsal bristle is attached somewhat nearer the point of the process than its distance from the main spine and considerably more distally than the latter; it extends a not inconsiderable

distance distally of the point of the process. The dorsal serrate teeth are rather few, but large. The main spine is moderately developed. Four ventral spines are developed, of which the two distal ones are very weak, scarcely perceptible. On the part distally of the main spine four or five transverse rows of hairs were observed. The rod-shaped process seems to be armed distally with three short, coarse spines. Basale: The backward pointing process has four distal bristles, three or four triaena bristles and two dwarf bristles; on the specimen investigated the left mandible was armed with four triaena bristles, the right one with only three; it looked, however, as if the latter limb too had originally had four of these bristles. On both limbs the anterior triaena bristle was rather decidedly reduced; it was only about half the length of the others. The triaena bristles are armed with from two to five pairs of spines proximally of the main pair of spines. The glands of this process emerge on an almost entirely reduced peg. At about the middle of the dorsal side of this joint there is a single bristle, which is about half as long as the dorsal side of this joint and has short, fine hairs distally. In addition this joint has a few groups of short fine, stiff hairs dorsally on the outside. The exopodite is, if its two distal bristles are included, about two-thirds of the length of the anterior side of the first endopodite joint. Endopodite: Of the three ventral bristles on the first joint the shortest one has, somewhat proximally of the middle, about ten to fifteen long secondary bristles arranged on all sides; distally of these there are short hairs. The two other of these bristles have no short secondary bristles proximally of the long ones. This joint is not armed antero-distally with spines. Second joint: this has two proximal bristles (length?). There is no long, narrow, short-haired bristle between the main bristles b and c. The medial cleaning bristles were alike on the right and left mandibles of the specimens investigated: there were five bristles in a distinct lower row, two bristles below the main bristle b and one between the main bristles a and b. The end claw is powerful and about as long as the anterior side of the first endopodite joint; it is smooth.

Maxilla (fig. 6): — Protopodite: The distal endite is armed with three subequal bristles. The dorso-proximal bristle is short. The basale has one moderately long ventral bristle and one dorso-distal bristle which is somewhat shorter than the former bristle. This joint has a short ventero-distal bristle developed, though it is extremely short and weak. Endopodite: The postero-distal bristle of the first joint is about as long as or only slightly shorter than the bristle of the end joint.

Sixth limb: — This seems to have six anterior ventral bristles; the number of posterior ventral bristles could not be determined with certainty. On the anterior edge of this limb there are, besides the two bristles that are usually found in species of this genus, five additional rather short bristles (these were found only on the limb of one side; that of the other side was defective at this place).

Seventh limb: — This is armed with fifteen or sixteen cleaning bristles of moderate and somewhat different lengths; of these bristles six are situated distally on the limb, three on each side, the others are scattered somewhat proximally of the former ones; there are about the same number on each side. Each cleaning bristle is armed with only from one to three bells. Each end comb consists of about eight teeth, which are finely, evenly and similarly pectinated (about the same as is shown in fig. 13 of *A. quinquesetae*).

The furca has eight claws, of which the six anterior ones may be termed main claws, the two posterior ones secondary claws. The anterior ones are not furnished with proximal ventral teeth.

There are no lateral eyes. The median eye has no hairs.

The male is unknown.

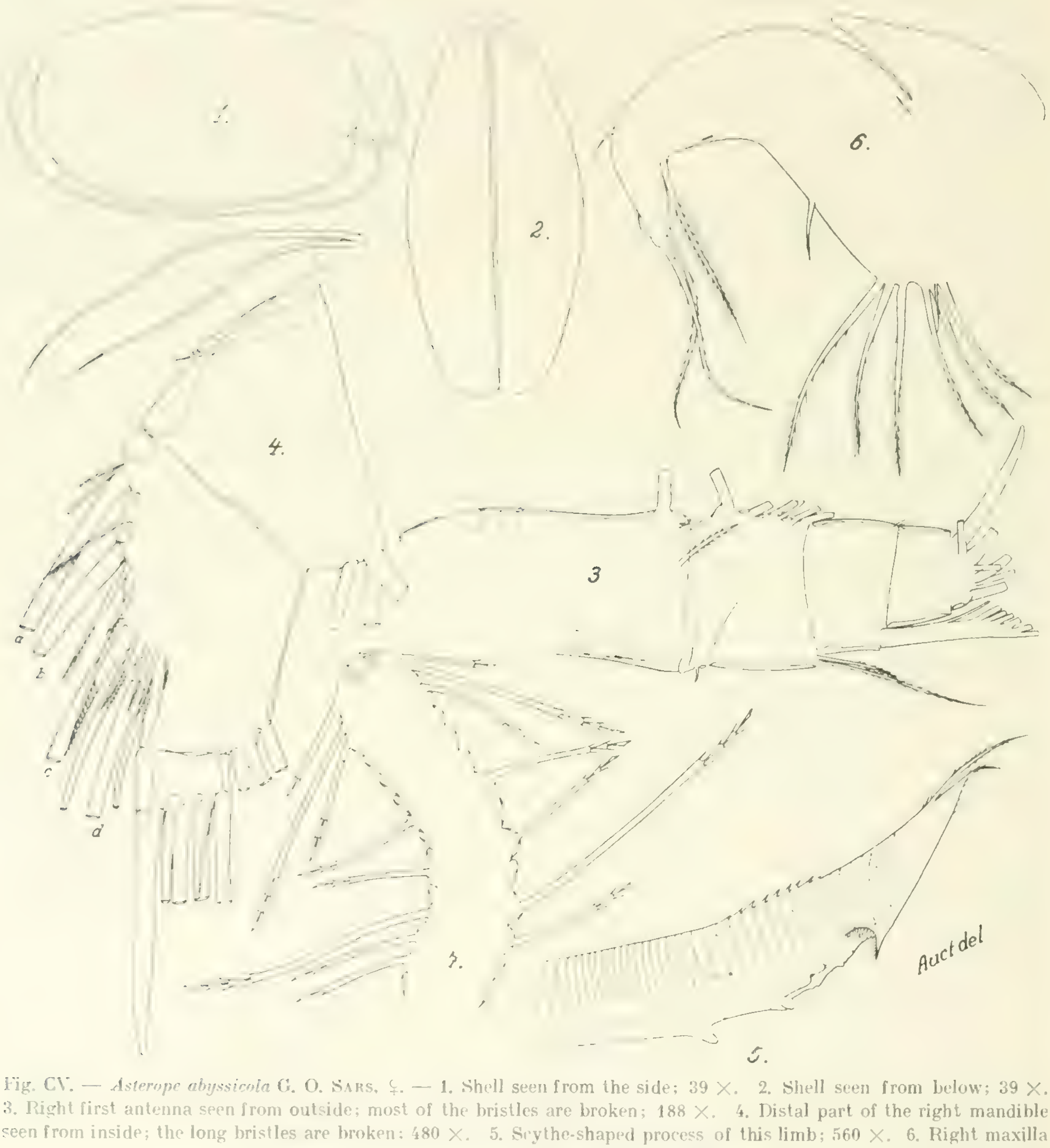

Fig. CV. — *Asterope abyssicola* G. O. SARS, ♀. — 1. Shell seen from the side; 39 ×. 2. Shell seen from below; 39 ×. 3. Right first antenna seen from outside; most of the bristles are broken; 188 ×. 4. Distal part of the right mandible seen from inside; the long bristles are broken: 480 ×. 5. Scythe-shaped process of this limb; 560 ×. 6. Right maxilla seen from inside; 240 ×. 7. Seventh limb; 272 ×.

Remarks: — The re-description of *A. abyssicola* given above is based on an investigation of a single specimen, a female with large eggs in the brood chamber, which was kindly placed at my disposal by Professor G. O. SARS and which was denoted by this writer as the type specimen of this species. It is certain, however, that this statement of G. O. SARS's was not quite correct. This is shown by the fact that the specimen sent to me was not dissected, while the original description was obviously made from a dissected specimen. The specimen investigated by me is probably, however, one of the two specimens that G. O. SARS mentions 1870, p. 171: „Kun 2 Exemplarer af denne lille Cypridinide toges ved Guldbrandsøerne paa 120 Favnes Dyb."* This is supported by the habitat, among other things: „Lofoten 120 F." The preparations of the dissected type specimen have, according to what Prof. SARS replied to an enquiry of mine, been certainly irrecoverably lost. It seems, however, to be beyond all doubt true that the specimen re-examined by me belongs to this species. *Material.*

As the specimen in question was somewhat defective I was unfortunately not able to give such a complete description of the species as is desirable, but I hope that in spite of the incompleteness the description will permit of a certain identification of the species. The characters that could only be described incompletely or to which a certain amount of uncertainty is attached are as follows: The medial bristles of the shell; the number of bristles on the anterior side of the original third joint and the equipment of the bristles of the end joint of the first antenna; the number of bristles on the end joint of the exopodite of the second antenna; the bristles on the sixth limb and the number of furcal claws. With regard to the number of bristles on the end joint of the exopodite of the second antenna it may be pointed out that on this antenna of one side — on the other side the two distal joints on the natatory branch were missing — three bristles were observed on this joint, one long one and two short ones, the two latter of about the same relative length as the two short ones in figure 5 of *A. Grimaldi*. I did not succeed in deciding with certainty whether an additional (long) bristle had existed originally, in other words if this joint is characterized by four bristles, the usual number in species of this genus. It seems, however, very probable to me that this was the case. The sixth limb is certainly of the same type as is usual for this genus, with a large number of ventral bristles. Both the furcal lamellae were armed with eight claws. But this organ seemed to be somewhat damaged behind the posterior claws, so that I am not quite certain whether one or more additional claws may not have existed originally. *Incompleteness of the description.*

As will be seen from a comparison there is a close resemblance between G. O. SARS's original description and the re-description of this species given by me above. There are, however, a number of differences. Thus G. O. SARS states that the shell is only 1.32 mm. long, while, as is seen above, I found it to be 1,63 mm. At present of course I cannot express any certain opinion as to whether this difference in length is due to the fact that the specimen measured by G. O. SARS was a larva or if the species is subject to such great variations in length at the same locality. But the fact that, if we assume the specimen measured by G. O. SARS to be a larva in the first stage, we obtain a coefficient of growth of 1.23 (1.63 : 1.32 = 1.23), i. e. about the same coefficient as I found for other closely-related forms (*A. Grimaldi*, *Cypridina (Doloria)* *Differences between G. O. Sars's description and mine.*

* Only two specimens of this small Cypridinid were taken at the Guldbrand Islands at a depth of 120 fathoms.

pectinata and *Philomedes* (*Ph.*) *globosa*; cf. p. 146 of this treatise) is in favour of the first alternative. For this reason I have not adopted the statement as to length given by G. O. SARS. I give for what it is worth G. O. SARS's information as to the shell: „altitudine maxima . . . ante medium sita" and the statements that „antennae, pedes mandibulares et maxillae structura fere exacta eadem ac in *A. norvegica*" and „laminae postabdominales breves unguibus 5 . . . armatae".

The description of this species given by G. S. BRADY and A. M. NORMAN, 1896, p. 636, is only a translation of SARS's original description into English. Two figures of the shell, one representing the side view, the other the shell as seen from below, are added by these authors, pl. LII, figs. 18, 19. The figures were drawn from a specimen of which it is stated that it was „kindly given to us by the describer", i. e. presumably the same specimen as is re-described and reproduced by me above. Of these two figures no. 18, that of the shell seen from the side, shows a fairly close resemblance to fig. 1 given by me above, the other figure, the shell seen from below, differs, on the other hand, very considerably from the corresponding figure given by me. This is perhaps due to the superficial way in which these writers have proceeded. It does not seem impossible, however, that there has been a confusion between the figures and that pl. LII, fig. 17, *A. elliptica*, the shell seen from below, represents *A. abyssicola*, while fig. 19 belongs to *A. elliptica*. At any rate, if this change were carried out, there would be considerably closer agreement between the figures given by BRADY and NORMAN and the forms that are actually found in nature.

Distribution: — Lofoten, Norway; depth, 220 m. (SARS 1870). Between Finmark and Beeren Island (Station 290 of the Norwegian North-Atlantic Expedition 1876—1878); depth, 345 m. (SARS 1886).

Type specimen of the re-description on slides in the Chr. Z. M.

Genus Cyclasterope G. S. BRADY.

Cyclasterope, G. S. BRADY, 1897. *Asterope*, G. W. MÜLLER, 1890 and 1912. *Cylindroleberis*, G. W. MÜLLER, 1906 b.

Diagnosis: — Shell: — This varies very much in type. In most cases, but not always, however, it has a well-marked posterior corner. The rostral incisur is comparatively deep and narrow. The surface of the shell has no sharply projecting sculpture; it is almost smooth. It is strongly calciferous. The forms are relatively large.

First antenna: — Disto-posteriorly on the fourth joint there are more than two bristles, some of which are rather long. The sensory bristle of the fifth joint is very powerful in the male and has a very large number of accessory sensorial filaments on the medial side of the bristle, arranged in numerous more or less distinct stages. This antenna has seven bristles distally, both the d- and e-bristles are developed; the a-bristle is claw-shaped; the c- and f-bristles are much lengthened in the male.

S e c o n d a n t e n n a: — The p r o t o p o d i t e has a short bristle disto-medially close to the exopodite. E x o p o d i t e: The first joint has no bristles. E n d o p o d i t e: The first joint has a number of short or moderately long bristles.

M a n d i b l e: — This is very powerfully built, rather elongated and has its joint decidedly flattened at the sides. P r o t o p o d i t e: Coxale: This has no bristles. The scythe-shaped process has comparatively numerous and large ventral spines. Basale: The backward pointing process is well developed and is armed with rather numerous bristles. Dorso-distally this joint has two bristles and in addition to these it has a relatively large number of bristles dorsally and ventrally. The e x o p o d i t e is comparatively well developed. E n d o p o d i t e: The first joint has a rather large number of bristles ventrally at the middle; apart from these it has no bristles. Second joint: Along the whole of the anterior edge there is a forest of exceedingly numerous bristles situated close together. The medial cleaning bristles are also very numerous and are arranged in transverse rows anteriorly on the joint. Postero-distally on this joint there is a group of a rather great number of bristles. The anterior bristle of the end joint is not claw-shaped.

M a x i l l a: — The p r o t o p o d i t e has a large lamelliform epipodial appendage, which is about half as long as the basale. The latter joint has dorso-proximally very numerous bristles arranged in a row. There are no endites distinctly developed. The baleen bristles are of the same type as in the genus *Asterope*; the proximal bristle in the baleen is also of about the same type as in this genus. E n d o p o d i t e: The end joint has a number of bristles.

F i f t h l i m b: — The comb is relatively high and has along its ventral edge abundant bristles of somewhat different lengths and with fine hairs.

S i x t h l i m b: — Seen from the side this is shaped like a broad-axe; the posterior and anterior margins are rather strongly concave, the ventral margin is weakly convex; it has well pointed corners, both anteriorly and posteriorly. Seen from beneath it is somewhat sole-shaped anteriorly, flattened and with its anterior edge rounded; posteriorly it is narrow, lamelliform. Along the anterior edge and the larger part of the ventral edge it has abundant bristles.

S e v e n t h l i m b: — This is moderately long; its distal part is considerably widened. It has a comparatively large number of cleaning bristles, two or three of which are often situated near one another on the same side of the same ring. Distally it has four end combs, arranged in pairs, of which the two that belong to the one pair are situated dorsally and ventrally respectively of the other pair.

F u r c a: — The lamellae are short; their breadth is somewhat greater than their length. Each lamella is armed with about eight to ten slender claws, finely curved ventrally. Of these the anterior ones are relatively long, the others either decrease uniformly in length posteriorly, so that there is no distinct division into main claws and secondary claws to be observed, or else a few of the posterior claws are typical secondary claws. At the base of some of the middle claws there issues a rather powerful and moderately long bristle. Behind the claws there are abundant moderately long, stiff hairs.

Remarks: — The species of this genus that have been dealt with so far in the literature are unfortunately very incompletely described. It was therefore impossible to carry out a

detailed description of the genus; only a short diagnosis could be given. It is thus probable that a number of the characters that are included in the description of the species given below are characters of the genus as well.

For the scope of this genus and the contrast between G. W. MÜLLER's and my ideas about it see above, p. 441 under the remark on the family *Asteropidae*.

Type species: *Cyclasterope Hendersoni*, G. S. BRADY, 1897.

Cyclasterope fascigera G. S. BRADY.

Cyclasterope fascigera, G. S. BRADY, 1902 a, p. 181, pl. XXI, figs. 20—31.
Asterope ,, G. W. MÜLLER, 1912, p. 44.

Description: — Cf. G. S. BRADY, loc. cit.

Male: —

Shell: — Length, 5,8—6 mm.; length : height about 1,75 : 1; length : breadth about 1,8 : 1. Seen from the side (fig. 1) it is rather elongated, sub-ovate, with the posterior part somewhat larger than the anterior part and the greatest height just behind the middle. The dorsal and ventral margins have about the same shape; they are moderately and somewhat irregularly curved and somewhat flattened anteriorly. They pass without any corners into the boldly and uniformly rounded anterior margin. The latter has about the same shape on both the valves and is not unsymmetrical, as G. S. BRADY has represented it in pl. XXI, fig. 20. The rostral incisur is situated at about half the height of the shell; the ventral corner of the rostrum is almost rectangular, not at all or very slightly rounded. The posterior margin of the shell forms, somewhat dorsally of half the height of the shell, a rather sharply marked corner, which forms an obtuse angle and is only weakly rounded; it is uncertain whether this is found on both valves, as this part of the right valve was somewhat damaged in the only specimen that was at my disposal. Both dorsally and ventrally of this corner the posterior margin of the shell is almost straight; it is bounded from the ventral margin by a weak, broadly rounded, scarcely perceptible corner or it passes evenly into it; its passage into the dorsal margin is marked by a slight sinuation. „Seen from above the outline is elliptical, with broad, slightly rounded or subtruncate extremities; lateral margins gently and evenly arcuate, greatest width situated in the middle" (G. S. BRADY, p. 181, pl. XXI, fig. 21). The surface of the shell is almost quite smooth, with only small, rounded, shallow foveolae, chiefly situated on the anterior part of the shell. There are scarcely any bristles. The wreath of hair round the posterior part of the shell is dense; these hairs are comparatively long and coarse. Seen from within (fig. 2): Right valve: The ventral lip of the incisur forms a heel-shaped part, which projects rather decidedly and is cut off obliquely dorsally. The antero-ventral part of the rostrum also projects like a heel. Somewhat inside and running about parallel to the anterior part of the dorsal and the dorsal part of the anterior margin of the shell there is a dense series of very small, rounded and strongly refractive formations resembling a string of pearls.

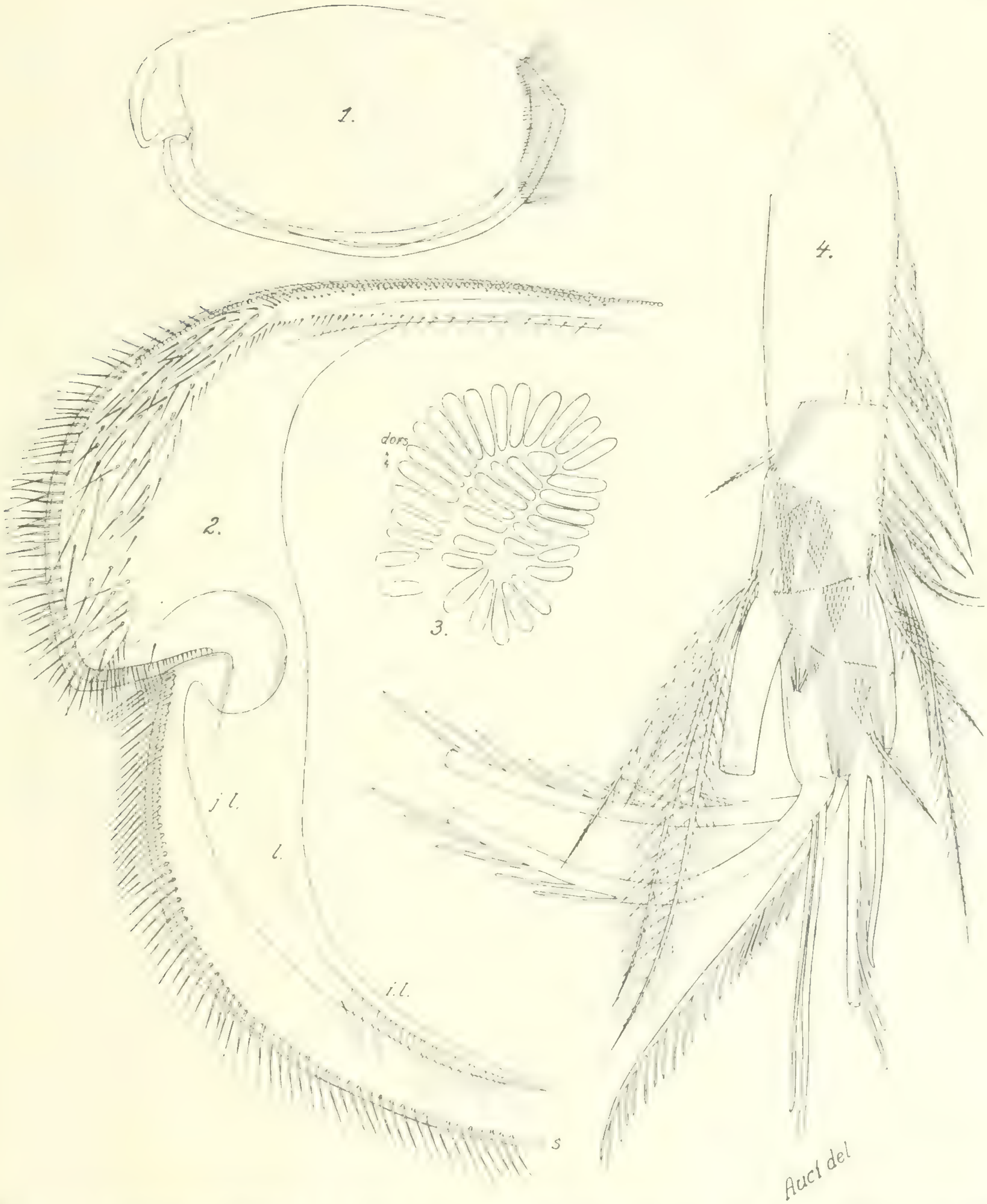

Fig. CVI. — *Cyclasterope fascigera* G. S. Brady. ♂. — 1. Shell seen from the side; 13 ×. 2. Anterior part of the right valve seen from inside; 52 ×. 3. The fixing spots of the shell muscle, right valve seen from inside; 56 ×. 4. Left first antenna seen from inside; all the long bristles are broken; [illegible] ×.

Medial bristles: These are all simple and bare. Somewhat inside and about parallel to the above-mentioned string of pearls a distinct and dense row of fine, comparatively short bristles runs along the anterior part of the dorsal margin of the shell. Somewhat inside and about parallel to this row of bristles another row of bristles runs, continuing down towards the point of the rostrum along the posterior edge of the rostrum — this edge is not distinctly marked, however; this row of bristles is partly rather sparse and also less distinct ventrally; its dorsal bristles are rather short and fine, its ventral bristles somewhat longer and more powerful. Basally on the outside of the selvage a series of comparatively long and powerful bristles issues along the anterior and ventral margins of the rostrum; this row of bristles is rather dense, even very dense along the ventral margin of the rostrum. Besides the bristles so far mentioned there are scattered on the rostrum abundant more or less long and powerful bristles. Basally on the outside of the selvage a relatively dense series of comparatively long and powerful bristles issues along the whole ventral margin of the shell from the incisur to a short distance behind the wreath of hairs round the posterior part of the shell; this row of hairs continues on the ventral lip of the incisur to the outside of the „heel". From the incisur to about a third or a half of the distance along the shell the part between the bristles in this series bends outwards into a semi-circle; posteriorly, on the other hand, there is no such undulation. On the list there is a rather dense series of bristles varying in length along the whole ventral margin of the shell; along the posterior margin of the shell the list is armed not only with bristles but also with a number of hyaline spines (this part of the list was very defective in the specimen I investigated). On the part between the list and the margin of the shell there seems to be a series of comparatively short bristles inside the ventral part of the posterior margin of the shell. Apart from this there seem to be scarcely any bristles here at all. The selvage is well developed along the whole of the anterior and ventral margins of the shell; it is moderately wide, has a smooth margin and is partly finely striated. The list is narrow along the ventral margin of the shell, somewhat wider along the posterior margin. For the fixing spots of the shell muscle see fig. 3. The left valve differs from the right in the following respects: The „string of pearls" inside the anterior part of the dorsal and the dorsal part of the anterior margin of the shell is absent. The semi-circular convexities between the anterior bristles in the series within the ventral margin of the shell are absent or are very weakly developed. On the part between the list and the margin of the shell there are a moderate number of fine bristles, varying in length, scattered along the ventral side of the shell. Inside the anterior part of the dorsal margin of the shell the selvage is split up into fine hairs at the margin.

First antenna: — This is rather long and slender, but powerful. It has six joints, the third and the fourth joints are free, the original sixth, seventh and eighth joints, on the other hand, are united, although the original boundaries between them can still be partly traced and on the lateral side the boundary between the sixth and seventh joints is even partly fairly well developed. The three muscles that move the seventh joint in the genus *Asterope* are well developed in this form as well and are attached posteriorly about half way along the definitive sixth joint on a common thickening of the chitinous wall. The relative length of the joints is shown by the following figures:

I [illegible]: II [illegible]: III [illegible]; IV [illegible]; V [illegible]: VI (orig.) [illegible]: VII (orig.) [illegible].

Along the distal half of the anterior edge of the second joint there is a series of seven moderately long bristles of somewhat different lengths, the proximal one rather short, all furnished ventrally with rather long, stiff secondary bristles arranged in two rows and with short hairs distally. Laterally this joint has three rather short, short-haired bristles near the distal boundary. Third joint: Along the anterior edge there are twelve bristles, five of which are attached along the boundary of the fourth joint. Of the five distal of these bristles the one situated most medially is relatively short, only about as long as the anterior edge of the fourth joint; the one situated most laterally is very long, about as long as or somewhat longer than the total length of the four (definitive) distal joints; the other three are rather considerably shorter than the last-mentioned one and decrease somewhat in length the more medially they are situated. The bristles situated proximally of these five are of moderate and somewhat different lengths. The two medial of the five distal of these bristles are furnished with comparatively short hairs, all the others are provided with a larger or smaller number of more or less powerful secondary bristles, in most cases arranged in two rows on the ventral side of the bristles; these bristles have most frequently fine, short hairs distally. Posteriorly this joint has a single moderately long bristle with short, fine hairs. Fourth joint: This has a single bristle antero-distally which is somewhat shorter than the total length of the two (definitive) distal joints and is provided with long, soft secondary bristles arranged on all sides, and is furnished with short hairs distally. Posteriorly this joint has five bristles distally, which increase somewhat in length the more laterally they are placed; the medial one is relatively short, not quite so long as the back edge of this joint, the lateral one is somewhat longer than the total length of the four (definitive) distal joints. The medial one of these bristles has short hairs, the others are rather abundantly supplied with soft, rather long secondary bristles along the greater part of their length. Sensory bristle of the fifth joint: This has a very powerfully developed stem, which is about as long as the posterior edge of the third to the sixth (definitive) joints. Distally it is rounded and has there about fifteen (the number was not quite certain, as the specimen was defective) sensorial filaments of about the same type; these are about half the length of the stem and are rounded distally and there provided with a short, fine sensorial hair. The accessory sensorial filaments are exceedingly numerous, somewhat narrower than the distal ones but of about the same length as these, and are arranged in about sixty more or less distinct transverse rows. The bristle of the original sixth joint is about as long as the posterior edge of the sixth definitive joint, with long, soft secondary bristles; it has short hairs distally. Original seventh and eighth joints: The a-claw is about as long as or somewhat shorter than the anterior side of the fifth and sixth (definitive) joints, is relatively narrow, and of almost uniform thickness along the greater part of its length, straight, directed ventrally and pointed distally; it is bare and only slightly annulated. The b-bristle is rather long, but considerably shorter than the c- and f-bristles (broken on both antennae); it has very numerous sensorial filaments. The c- and f-filaments are subequal, somewhat longer than the length of the shell, the lengths measured being 6.8—7 mm.; they have numerous sensorial filaments, 48—49 being observed on the c-bristle, 55—56 on the f-bristle. The d- and e-bristles issue, as in the males of *Asterope*, on a verruciform protuberance (cf. fig. 8 of *A. norvegica*), penetrate between the c- and g-bristles and are held medially; they are not quite as long as

the four (definitive) distal joints, the d-bristle is somewhat thicker and slightly longer than the e-bristle; proximally they, like the other distal bristles, are rather strongly annulated, distally they are finely and closely annulated, almost hyaline. The g-bristle is not quite so long as the anterior sides of the second and third joints; it is furnished with twenty sensorial filaments. The sensorial filaments on the b-, c-, f- and g-bristles are annulated proximally and almost hyaline distally; they are bare and end distally in a short, fine sensorial hair; on the b-, c- and g-bristles they are situated on the anterior side of the bristle, on the f-bristle on the posterior side, i. e. in the same way as in *Asterope*. Pilosity: The first joint is almost bare; the second joint has very abundant short, fine hairs on the medial side; otherwise it is bare.

Second antenna: — The exopodite (fig. 8) is somewhat shorter than the protopodite. The proportion between the joints is about as follows:

$$\mathrm{I : II : III : IV : V : VI : VII : VIII : IX} = 39 : 7 : 3 : 2 : 2 : 2 : 2 : 2 : 2.$$

In other words the first joint is considerably longer than the total length of all the following joints; the second joint is about as long as the two or three following joints. The second to the eighth joints have subequal and powerful natatory bristles, which are about as long as the exopodite or somewhat longer and are furnished along their whole length with comparatively long and broad natatory hairs situated very close together but have no spines at all. Distally these bristles are hyaline and end in a short, fine sensorial hair. The ninth joint has four such natatory bristles, of which the three situated ventrally are about as long as the natatory bristles on the preceding joints, the dorsal one is considerably shorter, being about as long as the total length of the eight distal joints. In addition this joint has medially a relatively short bristle which is only as long as the total length of the four or five distal joints; it too is provided along its whole length with long, powerful natatory hairs situated close together. The second to the ninth joints have basal spines; these are comparatively narrow, the one on the eighth joint being the longest, somewhat longer than the end joint; the rest decrease somewhat in length and strength the more proximally they are attached, the one on the second joint being very small and weak; the basal spine of the end joint is somewhat shorter and weaker than that of the eighth joint. The second to the eighth joints have medio-dorsally a mass of long, soft hairs distally; these are about as long as or somewhat longer than the joint that follows the one to which they are attached (only indicated in the figure). Latero-distally these joints have, in addition, a series of short, fine hairs. The first joint has also some groups of hairs distally. Endopodite: The three joints are all elongated and powerful, the distal one being rather slightly shorter than the second joint (fig. 9). Ventrally on the first joint there are a moderate number of moderately long or rather short bristles, which are finely annulated, rounded distally and end in a short, fine sensorial hair; on the second antenna of the right side there were five such bristles proximally and a series of four along the middle of the joint, on the left antenna the corresponding numbers were six and five (the number was, however, somewhat uncertain, one or more being possibly broken off). The second joint has a rather deep furrow ventrally, against which the end joint is folded back. At about two-thirds of the way along this joint there is ventrally a group of eleven or twelve moderately long bristles varying somewhat in length (the longest in the

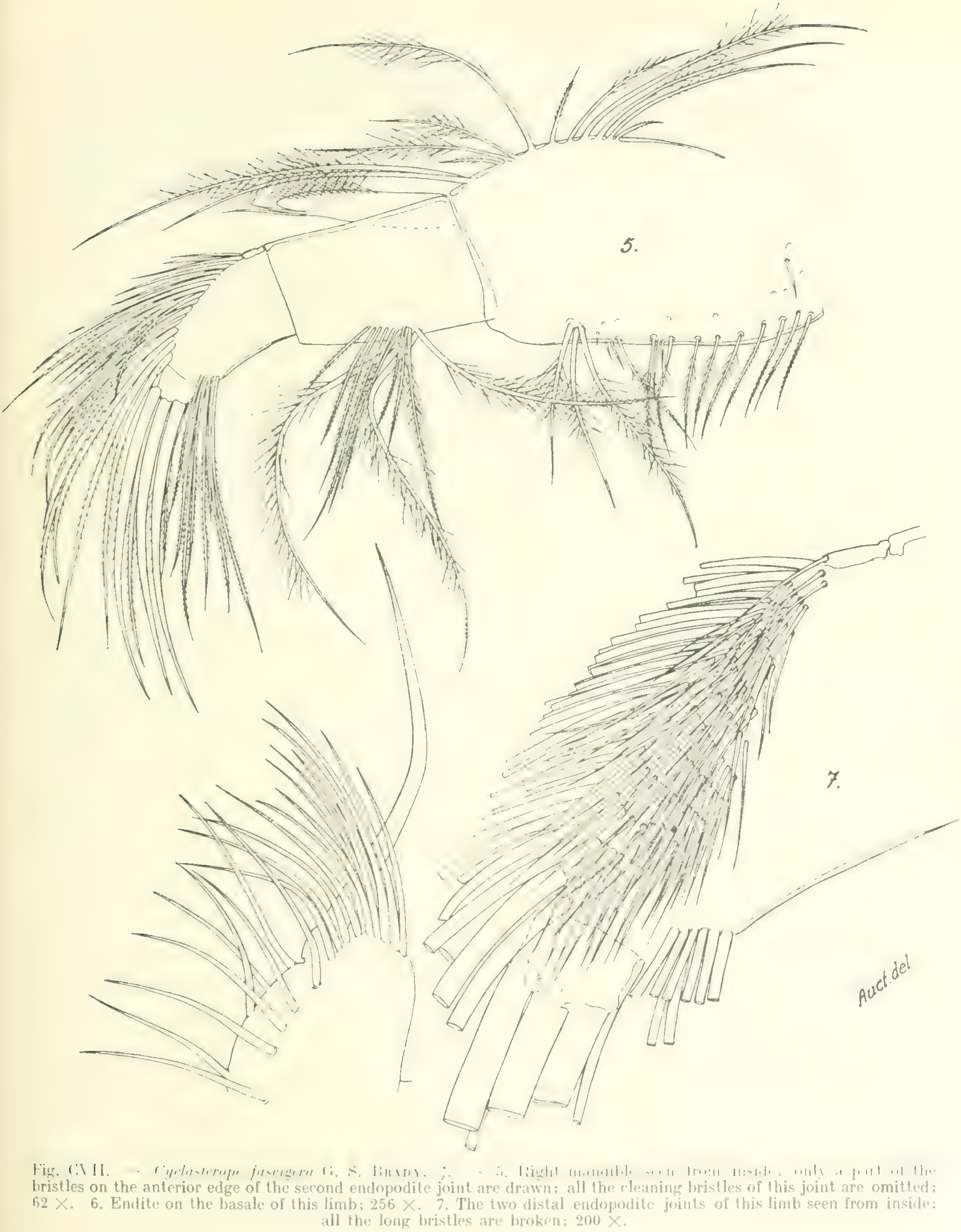

Fig. CVII. — *Cyclasterope fascigera* G. S. Brady. ♀. — 5. Right mandible seen from inside; only a part of the bristles on the anterior edge of the second endopodite joint are drawn; all the cleaning bristles of this joint are omitted; 62 ×. 6. Endite on the basale of this limb; 256 ×. 7. The two distal endopodite joints of this limb seen from inside; all the long bristles are broken; 200 ×.

adjoining figure are broken); these bristles are of the same type as those on the first joint. The end joint is rather broad proximally and grows uniformly and gently narrower distally. Along the distal half on the inner side (the dorsal side) it is „more or less distinctly cross-furrowed". Its proximal basal bristle is about half as long as the joint or somewhat longer. This bristle is of about uniform thickness, distally rounded; its proximal part is finely annulated, its distal part hyaline.

M a n d i b l e (figs. 5—7): — The proportion between the joints is about as follows:

$$\text{I Pr. } \tfrac{25}{21}\text{; II Pr. } \tfrac{20}{25}\text{; I End. } \tfrac{15}{15}\text{; II End. } \tfrac{13}{10}\text{; III End. } \tfrac{2}{2}.$$

P r o t o p o d i t e: Basale: Along the dorsal side of the backward pointing process there are about 20—30 bristles (the exact number could not be ascertained with certainty because the bristles on the proximal part of the process were defective). Most of these bristles are subequal and of moderate length and strength; one of those situated distally is about twice as long as the others and is considerably stronger than these; they are all bare or only rather weakly pectinated. Along the ventral side of this joint there are a rather large number of bristles: At about two thirds of the way along the joint there is a group of three rather long bristles, the longest of which is about as long as the height of this joint. Behind this group there is a series of about seven to ten subequal bristles, which are somewhat weaker than the three former ones and only about as long as half the height of the joint. Of these latter the anterior ones, like the three former ones, have long, stiff secondary bristles at the middle and have short hairs or are almost bare distally; the posterior ones have short hairs. In addition to these bristles there are ventrally a number of more or less short, bare or almost bare bristles; the number of these is not known on account of the defectiveness of the specimen investigated (a number are drawn in the adjoining figure, some are only indicated by marking the places where they are attached). Dorsally this joint has at the middle a series of ten bristles of different lengths, some of them long, about as long as the dorsal side of this joint or even somewhat longer, the shortest only about a fifth or a sixth of this length. The shorter ones of these bristles have short hairs, the long ones have long, stiff secondary bristles at the middle and have exceedingly fine short hairs or are bare distally. This joint has also two dorso-distal bristles of somewhat different lengths; they are of about the same type as the long dorsal bristles, but somewhat longer. E x o p o d i t e: This is about as long as the first endopodite joint. Its two bristles differ somewhat in length, the longest is only about half the length of the exopodite; they are short, have fine hairs or are almost bare. E n d o p o d i t e: First joint: Ventrally this has a group of three bristles of about the same length and type as the dorso-distal bristles on the second protopodite joint (corresponding to the three similarly placed bristles in the genus *Asterope*?). Close to and in front of this group there is a row of nine considerably weaker and shorter bristles; these are of different lengths, the longest being about as long as or somewhat longer than this joint, the shortest only about half as long; all these bristles have short hairs except one or a few of the posterior ones, which have long, stiff secondary bristles at the middle. Second joint: On the anterior edge there are exceedingly numerous powerful bristles of different lengths; it is impossible to establish the exact number of these because it is so large and because they are situated so densely. The proximal of these bristles are on the average rather considerably

shorter than the distal ones; the shorter ones among the former are only about half as long as this joint, the longest among the latter being almost as long as the total length of the first and second endopodite joints. The proximal ones have short hairs or are almost bare, the distal ones have moderately long, stiff secondary bristles. The numerous medial cleaning bristles are moderately long, subequal, finely pectinated or almost bare, arranged in about eleven or twelve transversal rows. Postero-distally on this joint there are eight bristles, two of which are situated somewhat distally of the other six; they differ somewhat in length, the longest are somewhat longer than the first endopodite joint; they all have short hairs. (Are the two distal ones of these bristles homologous with the two distal ones in the genus *Asterope*?) The end joint has five bristles. Three of these are subequal and comparatively powerful and long, about as long as the total length of the first and second endopodite joints, almost bare, with only sparse short hairs. One, situated between the two anterior of three former ones, is only slightly shorter than these, but considerably weaker; it has short hairs. The remaining one, situated behind the others, is of the same type as the last-mentioned one, but somewhat shorter. Pilosity: Basale: On the medial side there are rather abundant groups of moderately long, stiff hairs.

Maxilla (fig. 10): — Protopodite: Basale: Dorso-distally, a short distance from the boundary of the endopodite, this joint has a group of three long, powerful, bare bristles differing somewhat in length; the longest is almost twice as long as the endopodite. Proximally, close to these bristles, there is a very short and weak bristle and a short distance proximally of this another similar one. Distally of the three long bristles and on the inside of the joint, along the boundary of the endopodite, there is a series of eight more or less short, weak bristles. Ventero-distally there is a group of three relatively weak bristles on this joint, one of which is about as long as the height of this joint, the two others about half as long (exopodite?). Endopodite: First joint: Along the anterior side there is a series of four short bristles; the distal one is longest, the others shorter the more proximally they are placed. These bristles, like the short bristles of the basale, are bare or furnished with exceedingly fine, short hairs and end distally in a short, fine hair. Postero-distally this joint has a single bristle, which is about as long as the endopodite. The end joint has six rather long bristles differing somewhat in length; the longest is about the same length as the postero-distal bristle of the first endopodite joint. These bristles, like the postero-distal bristle of the first endopodite joint, have short hairs. Pilosity: The basale and the first endopodite joint are furnished on the inside with abundant groups of moderately long, stiff hairs.

Fifth limb: Comb (fig. 11): The dorsal edge forms, somewhat in front of the middle, a process that points somewhat forward and is rounded distally. On this process and along the proximal half of the dorsal edge of the comb there is a series of short, finely annulated bristles ending distally in a short, fine hair; seven of these bristles were observed on the right fifth limb, nine on the left. Of the bristles along the ventral edge of the comb those that are situated near the anterior point of the comb are on an average somewhat shorter than the rest. The remains of the distal exopodite joints are not distinctly defined as a verruca. They have two rather long, subequal bristles, the points of which do not reach the distal

edge of the comb; one of these bristles, situated somewhat distally of the other, has along its whole length long hairs situated close together and arranged in the shape of a feather, the other is also provided with similar hairs, but these are somewhat more sparse. Ventrally near these two bristles there are four short, weak, bare or almost bare bristles arranged in pairs and ventrally of these, near the ventral edge of the comb, there are two groups of weak, moderately

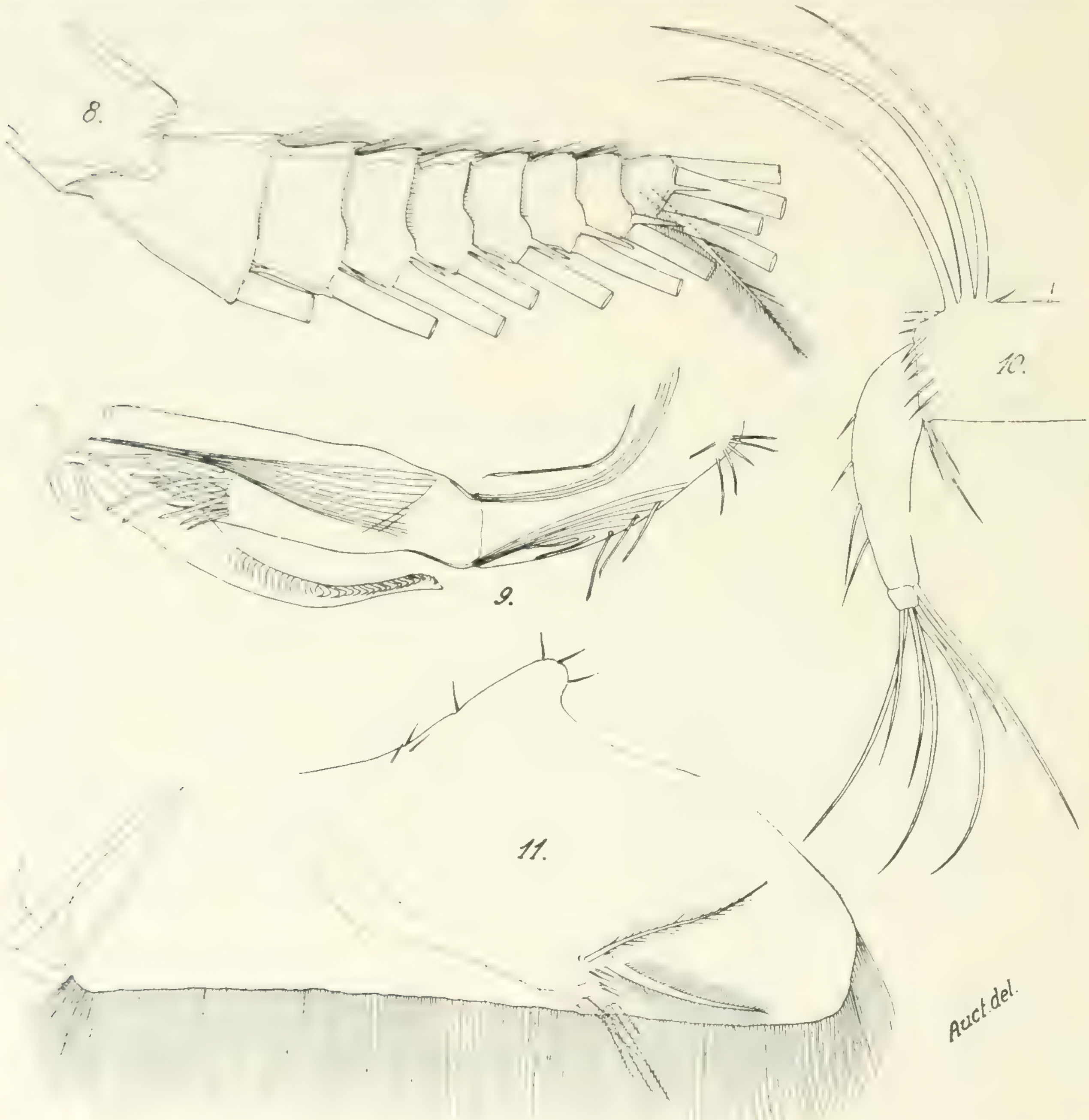

Fig. CVIII. — *Cyclasterope fascigera* G. S. BRADY. ♂. — 8. Distal part of the exopodite of the left second antenna seen from outside; all the long bristles are broken; 106 ×. 9. Endopodite of the left second antenna seen from inside; 76 ×. 10. Right maxilla seen from inside; 96 ×. 11. The comb of the right fifth limb seen from outside; 122 ×.

long or short, bare or plumous bristles; in one of these groups, the proximal one, three bristles were observed and four in the other. A weak chitinous list runs from the posterior dorsal corner of the comb to these groups of bristles. The epipodial appendage is somewhat ear-shaped, but perhaps not quite so marked as in the genus *Asterope*; its marginal bristles are of the same type as in this genus.

Sixth limb (fig. 12): — The bristles along the dorsal two-thirds of the anterior edge of this limb are arranged in three rather distinct rows, which are about parallel to each other; the following numbers were observed in the specimen that was investigated: 33 bristles in the outer

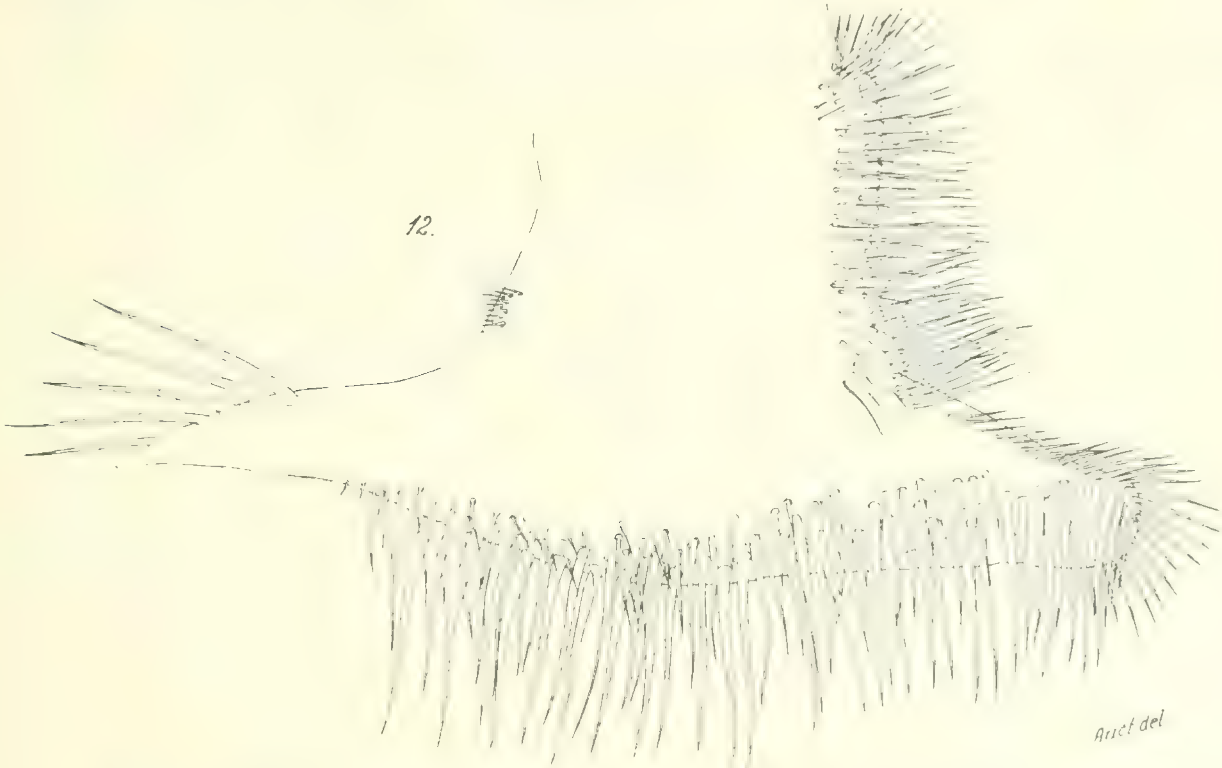

Fig. CIX. — *Cyclasterope fascigera* G. S. Brady. ♀. — 12. Left sixth limb seen from inside. 92

row both on the right and left limb, 25—27 in the middle row and 27—30 bristles in the inner row; in addition there were two or three bristles dorsally inside the inner row. Most of these bristles are moderately long, some rather short; all or at least the great majority of them are finely plumous. Along the ventral third of the anterior edge of this limb there is only one row of such bristles; this row continues ventrally out on the lateral side of the anterior sole-shaped part of the limb; 25—30 bristles were observed in this row; its dorsal bristles are somewhat shorter than the ventral ones. Along the anterior three quarters of the ventral edge of this limb there are about 80—90 bristles situated irregularly close together; of these those situated laterally are comparatively long, the medial ones more or less short. Some of the long ones have long, stiff secondary bristles at the middle and short hairs distally; others, like the shorter

bristles, have short hairs. Along the posterior quarter of the ventral edge of this limb there are no bristles at all. Along the ventral third of the posterior edge of the limb there is a series of five rather long bristles with long, soft hairs. At the middle of the posterior edge of this limb there is a group of nine short, bare or almost bare bristles (= the epipodial plate?). Pilosity: This limb is partly densely furnished with hairs both on the medial and the lateral side.

Seventh limb (fig. 13): — Almost every ring on the distal part of the limb has cleaning bristles both dorsally and ventrally. The specimen investigated by me had on this limb of one side 60 bristles on one edge and 63 on the other. Proximally there was in most cases only one cleaning bristle on the same side of the same ring, distally two or three in most cases. The cleaning bristles are moderately long or rather short; when two or three are found close to each other on the same ring, one is often moderately long and one or two relatively short. Each cleaning bristle has from one to eight bells which are cut off transversally distally; the longer cleaning bristles usually have more than the shorter ones; the tongue of the distal bell is moderately long and is cut off rather transversally distally. Proximally of the bells the cleaning bristles are bare. Each comb of the outer pair consists of about 10—14 teeth, all of the same type. These are armed at the middle with rather short secondary spines arranged in two rows; they are somewhat spade-shaped distally, with rounded point and even edge, cf. fig. 14. The number of teeth in the inner pair of combs could not be ascertained with certainty (it is presumably about the same as is shown in the adjoining figure), nor their type (as this organ was very dirty in the specimen that was investigated).

Furca (fig. 15): — This has ten claws. On the lamella of the right side these decreased fairly uniformly in length the more posteriorly they were placed; no distinct division into main claws and secondary claws could be observed; on the other lamella the four posterior claws were to be denoted as secondary claws. The anterior claws are armed ventrally along the greater part of their length with rather powerful, simple, pointed secondary teeth arranged in two rows; some of these spines are „arranged in sequences, one large one and one small one alternately" (G. S. BRADY, 1902 a, p. 182), but the difference in size is, however, rather slight, and others are of the same strength and size. On the claws situated farther back there is the same armature, but the teeth become weaker and weaker the farther back the claws are situated, those situated farthest back having only a fine pectination. Most of the more powerful claws have, in addition, more or less short, stiff hairs dorsally. At the base of the first and second claws there is a group of short, stiff hairs on the inside. Proximally anteriorly-laterally at the fourth to the seventh claws there is a powerful short-haired bristle, which is about a third or a half of the length of the claw.

Median eye and rod-shaped organ (fig. 16): — These are well developed. The former is bare. The rod-shaped organ is rather long and points upwards. It has two joints, the boundary of the joints being somewhat proximal of half the length; the distal joint is bottle-shaped, its proximal part being somewhat swollen, its distal part narrowing rather decidedly and its point rounded.

The lateral eyes are well developed.

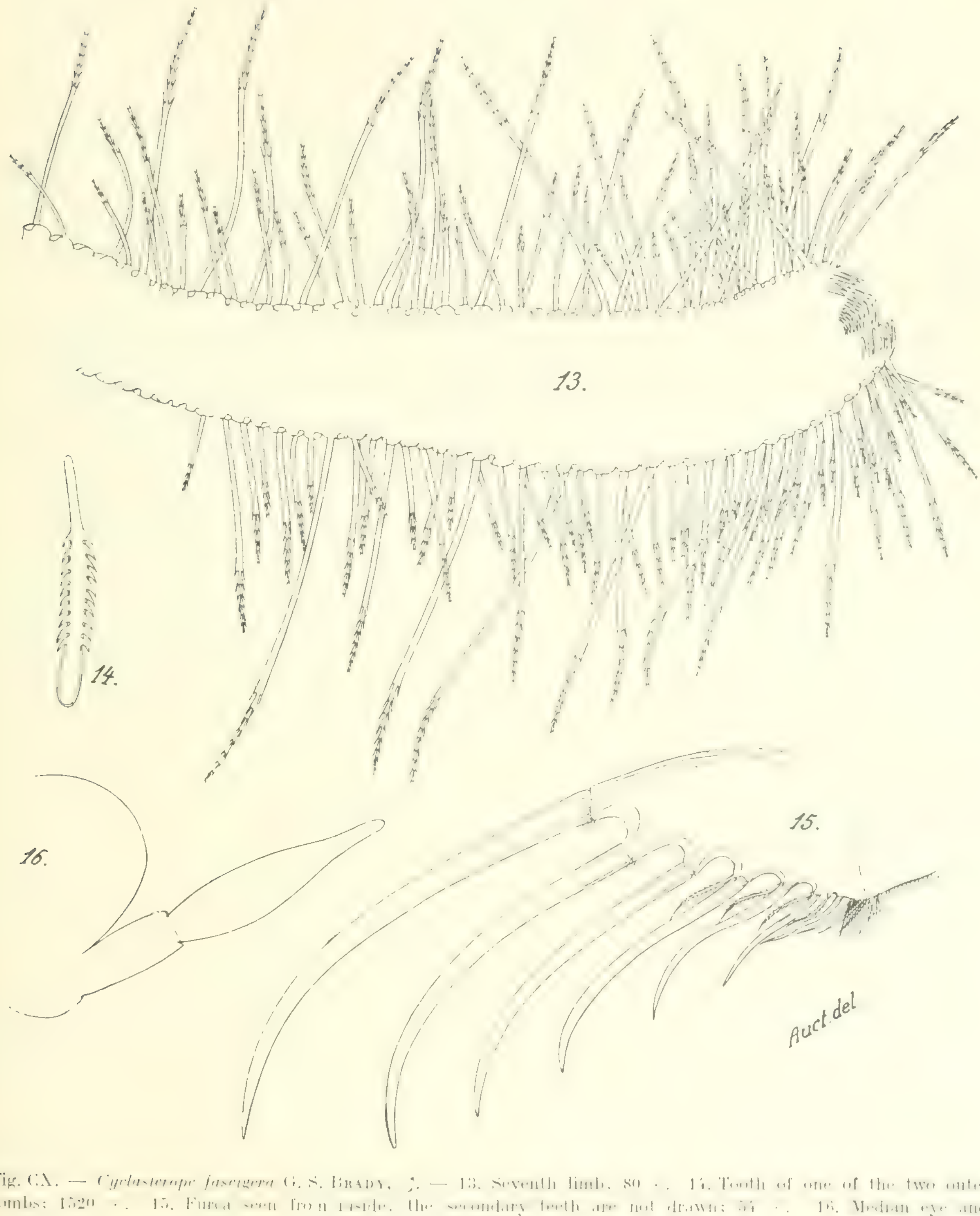

Fig. CX. — *Cyclasterope fascigera* G. S. Brady. ♀. — 13. Seventh limb, 80 ×. 14. Tooth of one of the two outer combs; 1520 ×. 15. Furca seen from inside, the secondary teeth are not drawn; 54 ×. 16. Median eye and rod-shaped organ; 86 ×.

There are eight pairs of g i l l s, rather broad and almost equally broad throughout their whole length; they are somewhat rounded distally.

F e m a l e: — Cf. G. S. BRADY, loc. cit.

[illegible] *Remarks.* — The re-description of this species given above is based on a single specimen which was kindly placed at my disposal for re-examination by the C o p e n h a g e n Z o o l o g i c a l M u s e u m. The specimen in question had been denoted as the type specimen by Professor G. S. BRADY, the describer of this species. This statement must, however, be considered incorrect, as the specimen was not dissected, and the original description was made from a dissected specimen. On the other hand there seems to be no doubt that the specimen really belongs to the species to which it has been ascribed.

[illegible] In several respects the specimen was not in a very good condition for the description of details; in addition some parts of it happened to be destroyed by an accident when it was dissected. Because of this the description given above had to be left incomplete in several points. In spite of this I hope it is complete enough to permit of certainty in identifying the species.

[illegible] Some divergencies from G. S. BRADY's original description may be noted, but for these it is only necessary to compare the two descriptions. These differences are probably to be explained as due entirely to the superficial method of investigation used in the original description.

Habitat. G. S. BRADY states that this species was caught at two localities in Java „Sourabaya, several specimens, ♂ ♀; Cheribon, $4\frac{1}{2}$ fathoms, one specimen, ♂". In addition one specimen, a male, is said to have been caught at Madeira. This last statement as to locality is certainly a mistake. It undoubtedly refers to the specimen described by me above. On the original label attached to this we read: „Madoura, øens østende, Andréa, 1870". In other words the specimen comes from the east end of the island of Madoera (Madura) on the north side of Java, near Sourabaya, i. e. from a locality in the neighbourhood of the two other localities.

Distribution: — J a v a.

Type specimen of the re-description on slides in the collections of the K. Z. M.

Sub-Order II. Halocypriformes.

Gen. *Conchoecia,* J. D. DANA, 1849, p. 51.
Sub-Fam. *Halocyprinae,* J. D. DANA, 1852, p. 1281.
Fam. *Conchoeciadae,* G. O. SARS, 1865, p. 114.
„ „der C o n c h o e c i a d e n oder H a l o c y p r i d e n", C. CLAUS, 1874 b, p. 7.
„ *Conchoeciidae,* G. O. SARS, 1887, p. 64 (236).
„ *Halocypridae,* C. CLAUS, 1888, p. 152.
„ „ G. W. MÜLLER, 1894, p. 221.
„ „ G. S. BRADY and A. M. NORMAN, 1896, p. 682.
„ „ G. W. MÜLLER, 1912, p. 53.

Diagnosis: — This sub-order comprises only a single family, the family *Halocypridae.* For the diagnosis of the sub-order I refer the reader to the diagnosis of this family given below.

Family Halocypridae.

Synonyms: — See sub-order *Halocypriformes.*

Diagnosis: — S h e l l: — There is in most cases a distinctly developed rostral incisur on the anterior edge. The dorsal margin is more or less straight, the ventral margin is in most cases more or less convex or straight, less often slightly concave. The posterior part of the shell is not siphon-shaped, the posterior margins of the two valves are, on the contrary, here situated close to or almost close to each other when the shell is closed. The valves are joined along less than half the periphery; the joined edges of the hinge never have any teeth. Within the free margin there is in most cases a very small number (sometimes even none or almost none) of medial bristles. There is only slight calcification (the preserved material is most frequently soft because of the more or less complete solution of the lime). Moderately large or rather small forms.

F i r s t a n t e n n a: — This issues high up on the forehead. There are never more than six clearly distinct joints. In other respects its type varies considerably.

S e c o n d a n t e n n a: — The p r o t o p o d i t e, which is situated by the side of the upper lip, issues from a rather narrow base and is very moveably joined to the body. It is large, relatively high, pear-shaped, in most cases somewhat more elongated than in the *Cypridiniformes*, somewhat flattened at the sides, with very powerful musculature, unjointed, without any evident traces of the boundary between the original joints and always without bristles*. E x o p o d i t e: This is very moveably joined to the protopodite, with which, when at rest, it forms a distinct ventrally open knee. It is developed into a powerful, elongated, (always?) nine-jointed locomotory organ, used in swimming. (All the species of this group that were investigated by me had constantly nine joints, but, according to G. W. MÜLLER, this branch has only eight joints in the genus *Thaumatocypris*; cf. the remark on this sub-family on p. 580 below.) Its first joint is always elongated and in most cases of about equal thickness along its whole length; most frequently it does not form disto-laterally a ratchet of the type characteristic for the *Cypridiniformes*. This joint is never armed with long natatory bristles. The eight following joints, of which the seven distal ones at least are short, become more and more narrow the more distally they are situated; the one next to the distal one is sometimes very small, even rather difficult to observe. Each of these eight joints are furnished disto-ventrally, somewhat medially, with a long and powerful natatory bristle. These bristles are annulated along the greater part of their length and are armed — also along the greater part of their length — with moderately broad natatory hairs, arranged in the shape of a feather. The end joint has a somewhat larger number (two or three were observed) of bristles; the ventral one of these is always a long natatory bristle, but usually somewhat shorter and weaker than those on the preceding joints; the other (or the others) are somewhat (more or less) shorter and weaker than the ventral one. All the bristles on this branch are without spines. Along the distal edge of a larger or smaller number of the second to the eight joints there is often a series of more or less weak spines; as I found this character varying rather considerably, I thought it best not to include it in the following descriptions. Basal spines in the sense in which this term is used by me in the group *Cypridiniformes* always seem to be absent in the *Halocypriformes*. The e n d o p o d i t e is always shorter than the exopodite, but is always well developed. It has never more than three joints; otherwise it varies in type. It is used only in exceptional cases as a locomotory (natatory) organ.

M a n d i b l e: — This is always powerful and elongated, and is chiefly used for holding the food fast and for mastication (also a climbing organ?). P r o t o p o d i t e: This is always two-jointed. The coxale, which is fixed obliquely forwards and downwards on the side of the body just behind the second antenna, is very powerful, strongly chitinized and very short and high; it consists of a rather narrow wedge-shaped dorsal insertion part, which forms the place of attachment for a number of very powerful muscles, and a particularly powerful ventral

* J. D. DANA (1852, pl. XC, figs. 4 b and 5 b and pl. XCI, fig. 8 e) draws a bristle distally on the protopodite of *Conchoecia* and *Halocypris*. In addition G. S. BRADY (1880, pl. XL, fig. 7) draws two long bristles at about the middle of the protopodite of „*Halocypris atlantica* LUBB“ (presumably = *Conchoecia serrulata* C. CLAUS). This is certainly due to mistakes on the part of these writers.

masticatory process, the pars incisiva. The latter part, which is in most cases bounded off from the dorsal insertion part by a slight contraction, is bent somewhat inwards, so that these processes on the right and the left mandibles are situated about opposite and rather near to each other, close to the mouth when these limbs are in a position of rest. The basale, which is rather moveably united to the coxale, is always large and powerful, rather elongated and, like the following joints, strongly compressed from the sides. Proximo-ventrally it is drawn out into a very powerful, broad, flattened masticatory process, which is cut off transversally distally and which covers the pars incisiva on the coxale from outside almost like a shovel. The distal edge of this masticatory process, which extends in most cases a short distance beyond the pars incisiva on the coxale, is armed with a row of teeth. (As G. O. SARS pointed out in his work of 1887, p. 74, the masticatory process on the basale seems to have the same function as the cutting part on the mandible in many other *Crustacea*, while the pars incisiva on the coxale serves as a sort of tuberculum molare to break up the food more finely. The latter process seems, however, also to serve partly as a cutting organ.) For the relation of the position of the masticatory processes on the coxale and basale to the atrium see G. W. MÜLLER, 1894, p. 48, pl. 1, fig. 19, pl. 40, fig. 66. An epipodial appendage is developed fairly often; it is moderately large or else small, with only one or two bristles (it never functions as a vibratory plate?); it is always situated on the medial side of the basale, more or less proximally on the joint. The exopodite is sometimes represented by a small, verruciform, unjointed process with or without a single plumous bristle or else only by a single plumous bristle. It is situated dorso-distally on the basale, most frequently somewhat medially and somewhat proximally of the distal boundary of this joint. It never seems to be quite absent. It does not contain the exits of any glands (as in the *Cypridiniformes*) and never seems to serve as a vibratory plate. The endopodite is always powerful and three-jointed, and forms a distinct, ventrally open knee together with the protopodite.

Maxilla: — This varies rather slightly in this group. It is developed as a masticatory organ, comparatively short and powerful and with a powerful musculature. It consists of a three-jointed protopodite and a two-jointed endopodite; the exopodite and the epipodial appendage are always quite absent. When in a position of rest this limb is situated as follows: The protopodite points forward and somewhat outward, the first joint of the endopodite points rather decidedly downward, there is a bend chiefly between the coxale and the basale; the first endopodite joint is twisted so that its greatest breadth almost coincides with the longitudinal axis of the body; the end joint points backward and downward or almost straight backward. Protopodite: This is comparatively short and thick. Its three joints are always well defined and are moveably joined to one another; the basale is moveably joined to the endopodite (both the coxale and the basale as well as the first endopodite joint are moved by special muscles). The procoxale and the coxale are comparatively large and powerful, the former being in most cases somewhat larger and stronger than the latter; the basale is rather considerably smaller than the procoxale and is moderately strong. The procoxale and the coxale are each armed with an endite. These endites are rather large and powerful, immoveably joined to these joints, flattened and armed

distally with strong bristles; they are situated almost at right angles to each other, the first endite points somewhat forward and inward, backward and outward, the second endite somewhat forward and outward, backward and inward; their relative positions and orientation in relation to the endopodite will be best seen from the adjoining diagram, fig. CXI, representing a horizontal section through the left maxilla. The endite on the coxale is not inconsiderably larger than the one on the procoxale and is weakly bifurcated distally. (This bifurcation has been taken by several of the preceding writers as a sign that this endite has arisen from the junction of two. It is difficult to decide how far this assumption is justified; there are no transitional forms; the assumption, which is obviously based on the fact that in the *Cypridiniformes* this limb has in most cases three endites on these two joints, seems to me, however, not improbable.)* The basale has no trace of any endite. E n d o p o d i t e: The first joint is comparatively large and powerful, moderately long but broad and rather considerably compressed at the sides. The end joint is rather small, moderately strong and varies somewhat in shape.

Fig. CXI. Horizontal section through the maxilla of a form belonging to the family *Halocypridae*. Diagrammatic.

For the differences between preceding writers' ideas about the various parts of this limb and that given above see p. 34 above.

F i f t h l i m b: — This varies rather slightly within this group. It seems to serve chiefly as an organ for holding the food fast during mastication and for carrying the food to the mouth, and perhaps as a masticatory organ, too; in addition it also seems to serve as a climbing organ. It is situated on the side of the body just behind the maxilla, at the boundary between the hypostome and the anterior part of the body. It is always rather large and has comparatively powerful musculature. It consists of a ventrally pointing protopodite, which is rather voluminous, comparatively elongated, unjointed or in exceptional cases more or less indistinctly two-jointed, and which is not or only rather slightly larger than the exopodite, a moderately large epipodial appendage developed as a vibratory plate, a very short, but rather powerful, unjointed** endopodite, pointing forward and inward and developed anteriorly as a powerful endite and a rather large and elongated backward pointing exopodite with three or four joints.*** P r o t o p o d i t e: In those cases in which this has two joints the boundary between the two joints is often rather weakly developed and difficult to distinguish with certainty; the proximal joint seems to correspond to the coxale or possibly the procoxale + the coxale, the distal joint to the basale. The proximal part, the coxale in the forms that have a two-jointed protopodite, is rather closely joined medially to the body and has no bristles at all. The distal part, the basale

* On the other hand it seems impossible to decide which of the two processes corresponds to the original second endite and which is homologous with the original third endite. This has been done, however, by G. W. MÜLLER, 1890 a, but without any reasons being given.

** In a number of forms (see, for instance, fig. 27 of *Conchoecia symmetrica*) one can sometimes distinguish distally on the endopodite a more or less well-developed chitinous fold. Is this to be explained as the remains of a division into joints?

*** In pl. VI, fig. 3, G. W. MÜLLER, 1906 a, the exopodite of the fifth limb of *Thaumatocypris* is drawn with four joints.

in the forms with two protopodite joints, is usually somewhat smaller than the part that corresponds to the coxale and has disto-anteriorly remains of endites, which are armed with a few bristles. Apart from these this joint is quite without bristles. The epipodial plate is elliptically oblong, situated vertically on the part of the protopodite that has been assumed above to be homologous with the coxale, and is joined to this throughout its length; along the posterior edge it has a moderate number of marginal bristles, arranged in three groups which are in most cases clearly distinct. These bristles are furnished along the greater part of their length with moderately long, fine, stiff hairs, placed close together and arranged in the form of a feather. The endopodite, which is moved by special muscles and projects rather far in between the protopodite and the exopodite, is armed with a rather large number of bristles. The exopodite is rather thick proximally and grows rather rapidly and uniformly thinner distally. Its end joint, armed with three bristles, is always very small.

See p. 46 above for the difference between the ideas of previous writers as to the morphological value of the various parts of this limb and the ideas about this problem that are expressed in the description given above.

Sixth limb: — This limb, too, is subject only to rather slight variation within this group. In the females it seems to serve chiefly as a climbing organ, in the males often as an auxiliary organ in swimming, but in some cases, in the males of the genera *Archiconchoecia* and *Halocypris*, genera which show only rather slight or no dimorphism in this limb, it is, as in the females, chiefly a climbing organ; on the other hand it never seems, either in males or females, to be used in mastication or taking up food. It is situated on the side of the body, just behind the fifth limb. It is always rather large and has well-developed musculature; it is always stronger and larger in the male than in the female. It is constructed according to the same type as the fifth limb, consisting of a voluminous, rather elongated, ventrally pointing protopodite, which is sometimes more or less distinctly two-jointed, but in most cases unjointed, and which is always somewhat shorter than the exopodite, a moderately large epipodial appendage that is developed as a vibratory plate, a very short, unjointed endopodite (sometimes not bounded off from the protopodite and then not possible to establish) and a four-jointed, backward or backward-upward pointing exopodite, which is in most cases somewhat more elongated in the males than in the females. Protopodite: This is of quite the same type as the one on the fifth limb; like the latter, it is closely joined to the body proximomedially, but it is quite without any trace of endites. The epipodial appendage has about the same size, type and position as this organ on the fifth limb; it differs from this chiefly by the number of the bristles. The endopodite projects somewhat farther in between the protopodite and the exopodite than on the fifth limb; its muscles are very much reduced or are even quite absent; it has only a very small number of bristles. As in the case of the preceding limb the exopodite is rather thick proximally, and grows rather rapidly and uniformly thinner distally. Its end joint, armed with three bristles, is always small.

For the differences in the ideas about the different parts of this limb held by previous writers and those put forward in the present work see p. 50 above, the chapter on the general morphology of the limbs.

Seventh limb: — This shows no dimorphism and varies very slightly in this group. It seems to serve chiefly as a sort of cleaning organ, but its effectiveness does not seem to be very great; cf. G. W. MÜLLER, 1894, p. 73; it is probably to be taken as a very much reduced organ. Like the cleaning limb in the *Cypridiniformes* it is placed fairly high up on the side of the body, somewhat behind the sixth limb. When in a position of rest it points in most cases obliquely upwards and backwards. It is very small and consists of quite a short, two-jointed or unjointed stem, which grows somewhat narrower distally and is furnished with simple, moderately strong musculature. (The question of the morphological value of this stem seems at present impossible to decide with certainty; does it correspond to the protopodite + the exopodite or only to the exopodite? See p. 50 above. The latter alternative seems most probable to me.) The epipodial appendage and the endopodite are quite absent. The proximal joint, which is somewhat elongated, is quite without bristles. The end joint is short and has two well-developed distal* bristles.

The brush-shaped organ is quite absent.

Furca: — This is always well developed, rather large and powerful with short, broad lamelliform rami, armed with a varying number of claws: from two to eight were observed.

The heart is always developed?

Sensory organs — Quite blind forms**; no traces of either lateral eyes or a Nauplius eye, have hitherto been found. (G. O. SARS pointed out in his work of 1865, pp. 116—117, the following facts: „In basi vero antennarum superiorum corpuscula adsunt pluria lentiformia, irregulariter acervatis sed semper in stratu distincte nervoso collocata pigmento vero nullo circumdata, quae organa quamquam imperfecta visus esse videntur." In this writer's work of 1887, p. 70, too, the occurrence of similar bodies is pointed out „en Del eiendommelige lindseagtige Legemer, der maaske tør ansees for et Slags ufuldkomne Synsapparater"*** in the proximal part of the first antenna in a couple of the Scandinavian species of the genus *Conchoecia*. This observation is repeated by G. S. BRADY and A. M. NORMAN, 1896, p. 685; they point out that the first joint of the first antenna in *Conchoecia elegans* G. O. SARS „shows, irregularly scattered near its surface, a number of lenticular bodies overlaying patches of red pigment, perhaps rudimentary visual organs". I have found similar patches in the first antennae not only of *C. elegans* and *C. borealis*, the species referred to by G. O. SARS, but of a great number of species of this genus; in exceptional cases these are also found in other places, e. g. on the protopodite of the second antenna in, for instance, *C. hettacra* G. W. MÜLLER. It seems very uncertain whether these bodies are visual organs but it seems best not to make any statement as to their morphological value before any experiments at all have been carried out. In any case such statements could only be very uncertain.)

A rod-shaped organ† is developed in most cases.

* Only in exceptional cases, in single specimens, are three bristles found.

** For J. D. DANA's establishing of eyes (1852, p. 1297) see p. 562 below.

*** „Some peculiar lenticular bodies, which are perhaps to be interpreted as a sort of imperfect visual organs."

† G. W. MÜLLER proposes (1894, p. 163) as the „wahrscheinlichste, oder, wenn man will, am wenigsten unwahrscheinliche" explanation of the rod-shaped organ in the Halocyprids that it is a light-percipient organ, not, however, for forming images, but only for „eine Unterscheidung von hell und dunkel".

Some limbs are equipped with specific sensory bristles.

There are never any traces of gills.

The mother does not take care of the eggs after these are laid. The only exception to this rule so far known is the species *Euconchoecia Chierchiae*, dealt with by me in this work, in which the eggs are kept for a time between the back of the body and the shell of the female, as in the sub-order *Cypridiniformes*. I have not been able to observe any development of organs in the eggs that occur in the brood chamber of the species mentioned.

Habitat: — The forms are marine, all, as far as is known, holoplanktonic.

Historical: — While a rather large number of investigators, both early and modern, have contributed to the study of the morphology and classification of the *Cypridiniformes*, the Halocyprids, on the other hand, have been dealt with in detail by only a few writers. Because of this the history of the investigation of the latter group is considerably simpler than that of the former.

I should like to bring forward the following arguments against this explanation: 1) The organ has no pigment or other characteristics that are found in organs which are explained as visual organs. 2) It is impossible to establish any relation between the development of this organ and the strength of the light. The Halocyprids comprise forms that live near the surface of the sea as well as those that live at very great depths (G. W. Müller states, for instance, 1906 a, that a number of specimens were caught by the „Valdivia" with a closing net at depths of from 3300—2700 metres), and yet there is not the slightest indication that the great variation in this organ is in any way influenced by the strength of the light. 3) No relation seems to exist between the development of the rod-shaped organ and that of the median and lateral eyes, as is shown by the following examples. The Halocyprids, which have, as we know, in most cases an exceedingly well-developed rod-shaped organ, are quite without median and lateral eyes. In the sub-genus *Vargula* (I assume here that the rod-shaped organ has the same function in *Halocypriformes* and *Cypridiniformes*, an assumption which is made, however, with the greatest reservation; cf. p. 96 above), whose rod-shaped organ is short and thick and comparatively well developed, the lateral eyes are generally large. In such forms as have more or less completely reduced lateral eyes no reduction or increase can be established in the rod-shaped organ; examples of this are shown in the closely related species *Cypridina (V.) antarctica* and *C. (V.) norvegica*. In the *Macrocypridina* the lateral eyes are large, the rod-shaped organ is small. In *Crossophorus africanus* both the lateral eyes and the rod-shaped organ are reduced; cf. G. W. Müller, 1906 a, p. 135. *Philomedes* perhaps affords the best example. In this genus the rod-shaped organ is particularly well developed and has about the same type and relative size both in mature males and females and in larvae (it is probably developed even in the earliest postembryonal stages). The lateral eyes are, on the other hand, as we know, subject to very great variations in these forms. The females are quite or practically quite without lateral eyes both as larvae and mature specimens. The male larvae have lateral eyes, although these are rather small and comparatively slightly pigmented. The mature males of this genus are, on the other hand, as we know, furnished with large, well pigmented lateral eyes. Other examples from this sub-order could equally well have been chosen, the result would have been the same, quite negative. 4) Another argument against G. W. Müller's explanation is probably to be found in the position of the rod-shaped organ in relation to the light-producing glands in *Cypridiniformes*.

How are we then to explain the rod-shaped organ?

C. Claus has interpreted it as „Träger eines ausgeprägten Tast- und Spürsinnes" (1891 a, p. 35). G. W. Müller rejects this explanation in his work of 1894; this writer's proofs and counterproofs in this problem seem to me, however, anything but decisive. Perhaps we are obliged to say that it is an organ whose function we do not yet know. Perhaps we can — mutatis mutandis — apply in this case a statement of A. Sedgwick's (A Student's Textbook of Zoology, 1909, vol. III, p. 637): „It is more than probable that insects have sense organs which have no counterparts amongst vertebrate animals and these we cannot even hope to investigate". — I have myself carried out a large number of experiments on this organ at the Russian Zoological Station at Villefranche-sur-mer and at the Musée Océanographique of Monaco and I hope to present the results of these in a later publication.

As is seen above (p. 155), the Halocyprids were introduced into the literature by J. D. DANA. In his monumental work of 1852 this investigator gave a rather thorough and in some respects meritorious description of the general morphology of this group. The morphological value of the first and second antennae and of the mandible and the furca was thus correctly conceived, and these organs were described in a fairly satisfactory manner. A description that was on the whole correct was also given of the rod-shaped organ, „the exsertile speculum"; on the other hand nothing was stated as to the nature of this organ. But this writer made more or less serious mistakes in the explanation and description of the posterior limbs. It is true that the maxilla was explained correctly, „the first pair of maxillae", but its description is rather deficient. This author denoted the endite on the procoxale of the maxilla — the epipodial appendage of the fifth limb ; the seventh limb as the „second pair of maxillae"; the sixth limb was taken as the „first pair of feet" and the fifth limb without the epipodial appendage as „the second pair of feet". The description of these organs is also rather deficient. An additional mistake was committed by this writer; he thought that he had found in one species „two simple eyes near the medial line, just posterior to the base of the tentacles".

G. O. SARS's work of 1865 indicates a great advance, though unfortunately it is not illustrated. It may be said that the general morphology of the genus *Conchoecia* became fairly well known from this work. All the limbs were correctly explained and were described in a way that was on the whole very satisfactory; the sexual dimorphism of the first and second antennae and the sixth limb was pointed out; the upper lip and the male copulatory organ were described, though only in very general terms; the absence of eyes was established (for the occurrence of these organs in the first antenna see p. 560 above). This writer even perhaps observed the heart, but he only speaks indistinctly on this point (it is not quite clear if he means that the whole group *Myodocopa* is characterized by this organ or if it is only found in a number of representatives of this group; cf. p. 6).*

After this work our knowledge of the morphology of the Halocyprids has been increased still further. The most important works are the following: C. CLAUS, 1874 b and 1891 a, G. O. SARS, 1887 and G. W. MÜLLER, 1890 a and 1894. The most important of these works is perhaps the last-mentioned of C. CLAUS's, which is equally distinguished by its comprehensiveness as by its wealth of detail; this work made the Halocyprids the best known group among the marine Ostracods and one of the best known among all *Crustacea*. G. W. MÜLLER's Naples monograph is the last work in which the morphology of the Halocyprids is dealt with in detail.

In a preliminary work (1849) J. D. DANA collected all the species of this group investigated by him into a single genus, *Conchoecia*, and in 1852 he divided them into two genera, *Conchoecia* and *Halocypris*. From these genera this writer formed the sub-family *Halocyprinae*, which was grouped together with the sub-family *Cypridininae* to form the family *Halocypridae* cf. p. 155 above. — The descriptions of the genera *Conchoecia* and *Halocypris* were, however, exceedingly incomplete and partly incorrect as well. One result of this was that the succeeding authors formed a more or less completely erroneous idea of these genera; they were quite confused

* Otherwise C. CLAUS, 1874 b, p. 5, was the first to observe this organ.

by J. LUBBOCK, 1860. G. O. SARS was mistaken about the genus *Halocypris*; this writer included in this genus not only the species placed in it by J. D. DANA but also *Conchoecia obtusata* G. O. SARS and *C. curta* J. LUBBOCK [= *C. Clausii* (G. O. SARS)], two forms which do not belong here at all; cf. also G. O. SARS 1890, p. 53. G. S. BRADY, 1880 again combined these forms in one genus, *Conchoecia*, as he could not find in J. D. DANA's descriptions „any differences sufficient, in my opinion, to form grounds of generic distinction". TH. SCOTT, 1894, used the generic name *Halocypris* for all the species of this group that were investigated by him. The difference between these two genera had, however, already been pretty well settled in C. CLAUS's works, 1874 a and b.

G. O. SARS, 1865, employed the same classification as J. D. DANA, but with the difference that the latter investigator's family *Halocypridae* was denoted as the sub-order *Myodocopa* and the sub-families *Cypridininae* and *Halocyprinae* as the families *Cypridinidae* and *Conchoeciadae*; cf. p. 155 above. The Halocyprids are denoted by all other writers as a family; most of them use the name *Halocypridae*; cf. p. 555 above.

C. CLAUS, 1874 a, established a new genus *Halocypria* and G. W. MÜLLER 1890 a another, *Euconchoecia*, but apart from this these writers did not undertake any further division of this group in the works mentioned.

In C. CLAUS's work of 1890 we find the following far-reaching classification of this group:

Sub-family *Conchoecinae*	*Conchoecia* J. D. DANA.
	Paraconchoecia n. g.
	Conchoecetta n. g.
	Conchoecilla n. g.
	Conchoecissa n. g.
	Pseudoconchoecia n. g.
	Mikroconchoecia n. g.
Sub-family *Halocyprinae*	*Halocypris* J. D. DANA.
	Halocypria C. CLAUS.

This author uses the same classification in his following works (1891 a and 1894). His example was followed by several investigators: G. S. BRADY and A. M. NORMAN, 1896, G. S. BRADY, 1897, 1902 a, 1903, 1907, P. T. CLEVE, 1900, 1905, A. M. NORMAN, 1905 and A. SCOTT, 1905. (The last-mentioned writer only partly, as he denotes *Mikroconchoecia* as *Conchoecia*).

G. W. MÜLLER in his great Naples monograph, 1894, established a new genus of this group, *Archiconchoecia*. This writer strongly opposed C. CLAUS's classification just mentioned. On p. 223 of the work just referred to he pointed out, first, that of the seven genera into which C. CLAUS divided the genus *Conchoecia* no less than five were represented only by a single species and, secondly, that the differences that exist between these genera are rather slight. With regard to the classification of the sub-families *Conchoecinae* and *Halocyprinae* this author writes: „Da beide Formen" (*Halocypris* and *Halocypria*) „näher mit einander verwandt sind als mit *Euconchoecia* oder *Archiconchoecia*, oder als diese unter einander, so würde sich als Consequenz ergeben, daß wir für diese beiden durch je 1 Art vertretenen Gattungen je eine besondere Familie

aufstellen mußten. Man sieht, wir nähern uns dem Ideale mancher Systematiker, die aus jeder Art eine besondere Familie machen möchten." He then suggests that the family *Halocypridae* should be divided directly into four genera: *Conchoecia*, *Halocypris*, *Euconchoecia* and *Archiconchoecia*. No grouping of the species within the genera was undertaken in this work.

G. W. MÜLLER, in his monograph on the Ostracods of the Valdivia expedition, the most important work on the *Halocypriformes* after 1894, described a new and very different Halocyprid genus, *Thaumatocypris*, and put it as the sole representative of a new sub-family, *Thaumatocyprinae*, opposed to all the other Halocyprids, which were grouped into one sub-family, *Conchoecinae*. This last sub-family was divided by this writer into the same four genera as in his Naples monograph, namely *Archiconchoecia*, *Halocypris*, *Conchoecia* and *Euconchoecia*. The two first and the last of these four genera, which comprised a rather small number of species, were not divided any further. A splitting-up of the multiform genus *Conchoecia* (no less than 75 species of this genus are included in the work mentioned) was, on the other hand, desirable even for practical reasons. G. W. MÜLLER writes on this in the work in question (p. 52): „Auch gelingt es ja leicht, natürliche Gruppen abzugrenzen und wenigstens einige dieser Gruppen scharf zu charakterisieren (Gruppe *curta*, *rotundata*, *bispinosa*), bei anderen Gruppen gelingt entweder die scharfe Abgrenzung oder die Charakterisierung der Gruppe nicht *(spinifera, magna, mollis)*. Gewöhnlich greift man in ähnlichen Fällen die leicht charakterisierbaren Gruppen heraus, stellt sie als gleichwertige Gattungen der älteren, alle umfassenden Gattung gegenüber, in der man den undefinierbaren Rest beläßt, dessen Auflösung nicht gelingen will, und der dann keine natürliche Gruppe mehr darstellt, auch keine scharfe Charakteristik zuläßt. Man vergleiche z. B. das Schicksal der Gattungen *Cypris*, *Cythere* und *Cypridina*. Auch der Versuch von CLAUS, die Gattung *Conchoecia* aufzulösen, gehört bedingt hierher. Seine neuen, meist nur durch eine Art vertretene Gattungen repräsentieren natürliche Gruppen, die Gattung *Conchoecia* umfaßt Vertreter verschiedener Gruppen; doch wird hier wenigstens der Versuch gemacht, auch diese Gattung scharf zu charakterisieren. Ich halte ein solches Verfahren nicht für streng wissenschaftlich, habe deshalb von einer Auflösung in Gattungen abgesehen." In other words this author protests against a division into new genera of the genus *Conchoecia*, but puts forward the possibility of distinguishing natural groups; no less than sixteen such groups were established in this work. But he pointed out at the same time that it was perhaps possible that a careful study of the limbs to which no attention had been paid „schafft die Möglichkeit einer vollständigen Auflösung in Gattungen".

This writer uses the same classification in his later works (1912), but does not divide the genus *Conchoecia* into groups. He was followed by some other writers, e. g. CH. JUDAY, 1906 and T. R. R. STEBBING, 1910.

Description of the species.

Most of the works dealing with this group of animals are purely faunistic and descriptive of the species. The most important works on this subject are those of C. CLAUS, 1891a and G. W. MÜLLER, 1906a, b, c and 1908.

Postembryonal development.

The main features of the postembryonal development of the Halocyprids have become rather well known by C. CLAUS's works of 1893 and 1894 and G. W. MÜLLER's works

of 1893 and 1894. G. H. FOWLER's studies of the larval stages of the Halocyprids from the Bay of Biscay (1909) are interesting, especially because of the application of BROOKS's law.

The above work by G. H. FOWLER is also of interest because in it the working supposition was put forward that all the species of the genus *Conchoecia* (and other Halocyprids) „exhibit two stages with secondary sexual characters in the male".

Oecology.

The oecology of the Halocyprids is almost completely unknown. G. W. MÜLLER, 1894, put forward the assumption that these forms belong to the fauna of the bottom and that it was only in more or less exceptional cases that they travelled up among the plankton. But even in a treatise published the same year C. CLAUS put forward strong arguments in favour of these forms being holoplanktonic organisms. G. H. FOWLER, 1909, dealt with the vertical wanderings of the Halocyprids, the proportion between males and females and „the Death-rate".

Which of the two above-mentioned classifications of this group is to be preferred?

Remarks: — Which of the classifications of the *Halocypriformes* described above is to be preferred, the one worked out by C. CLAUS in 1890 or that of G. W. MÜLLER, 1906 a?

As will be seen from what follows, I have in the present work followed the latter entirely. When I began my investigations of this group I considered — like G. W. MÜLLER, 1906 a — that it was not impossible that a careful investigation of all the organs would make possible and even necessitate a splitting-up of the genus *Conchoecia* — sensu G. W. MÜLLERI — into a larger or smaller number of genera. But the results of my investigations quite refuted this supposition. The organs to which G. W. MÜLLER had paid no attention in his work of 1906 a, i. e. the mandible, the maxilla, the fifth, sixth and seventh limbs, the penis, the furca, the lips and the internal organs are subject to exceedingly slight variation within this genus. A division of *Conchoecia* into a number of genera, i. e. into units placed parallel systematically to *Archiconchoecia*, *Halocypris* and *Euconchoecia*, thus seems impossible to me too. On the other hand we can — as G. W. MÜLLER pointed out — distinguish more or less distinct and presumably natural groups within the first-mentioned genus. A number of these groups are rather strikingly characterized, e. g. the *Rotundata* group by the position of the unsymmetrical glands, the *Curta* group by the ramosity of one or more of the bristles on the first antenna. These groups, which are easily defined and characterized, can, of course, be distinguished as special sub-genera. But the method employed by G. W. MÜLLER seems to me preferable on account of its uniformity and consistency. A number, or, more correctly, most of the groups established by G. W. MÜLLER are very difficult to define: they are so interwoven in each other — often presumably by convergence — that the natural position of a good many of their species is and will presumably always be exceedingly problematical.

G. H. Fowler's supposition of two mature stages in the Halocyprids.

As has been pointed out above on this page G. H. FOWLER, in his work on the planktonic Ostracods of the Bay of Biscay (1909), put forward the interesting and, if correct, exceedingly important working supposition that all the species of the genus *Conchoecia* „exhibit two stages with secondary sexual characters in the male" (p. 258), i. e. these species have to undergo a further moult after they have attained maturity. According to this author a number of characters are altered during the last moult. On account of this two forms were in several

cases united under one species in the work in question, though these forms had been distinguished by preceding writers as special species on account of greater or minor differences.

Is this assumption of G. H. FOWLER's correct? For several reasons it seems to me that this question must be answered in the negative.

Its uncertainty is shown by the very fact that it is based exclusively on a material collected at a place so rich in closely-related species as the Bay of Biscay. An assumption of such a nature must, in my opinion, have a more certain basis than that presented by G. H. FOWLER.

It would, of course, be desirable to prove or disprove this assumption directly by experiments in aquaria. This was unfortunately, however, impossible for me because of the difficulty of keeping these forms in full vigour for a long period of time in aquaria.

Another method of setting to work at this problem would be to investigate closely the plankton material from districts which have few species of the genus *Conchoecia* and where these species are comparatively distantly related to each other. Skager Rak is a district of this kind. It is certain that there are only three species of this genus found here — at least regularly and to any large extent; this is shown with all the certainty that could be desired by the careful investigations carried out by the „Conseil permanent international pour l'exploration de la mer". These three species, *C. elegans* G. O. SARS, *C. obtusata* G. O. SARS and *C. borealis* G. O. SARS, represent three types of this genus that differ comparatively widely from each other. I have had material from this region at my disposal. This material comprised (1) numerous mature individuals and (2) larvae (of two or three different stages) of all these three species. On account of the characteristic shape of the shell in these species the larval forms are very easy to distinguish from each other with certainty. The fact that both larvae and mature individuals were found of all these three species shows, of course, with complete certainty that we are concerned with three different species and that none of them can be a „stage" of the other. It is certain that the mature specimens all belonged to the same stage. The variations in size were strikingly small: *C. elegans*: ♂ = 2,05—2,25 mm.; ♀ = 2,0—2,15 mm.; *C. obtusata*, ♂ = 1,15—1,35 mm., ♀ = 1,6—1,85 mm.; *C. borealis*, ♂ = 2,10—2,20 mm., ♀ = 2,5—2,7 mm. Other characters were practically quite constant in these specimens. The same result was obtained by the investigation of the material collected in February and that of August, a fact that is connected with the phenomenon that the development of the Halocyprids (like that of the Cypridinids) takes place continuously during the whole year. (Among the mature females that were investigated there were both old and young specimens: some of them had very small, others more or less large, eggs.)

I arrived at the same result after investigating the Halocyprids from the Arctic and the Antarctic Oceans.

It seems to be impossible to retain G. H. FOWLER's view under these circumstances. Nor does it seem to me necessary to criticize in detail the exposition put forward by this writer; I refrain from doing so all the more as such a criticism would necessarily be very lengthy, without the result being of any great value. Only a few striking facts need be pointed out.

In spite of obvious efforts G. H. FOWLER could not find two mature stages for more than eight of the species investigated by him; only one mature stage was found of the other

twelve. Among these twelve species there are several of which a fairly abundant material was at the disposal of the investigator, e. g. *C. spinifera* and *C. elegans*. This fact alone should have aroused the author's suspicion.

With regard to the eight former species I may point out the following facts:

C. zetesios: — Only two stages, „Stage (?) I“ and „Stage (?) II“ of this species, which G. H. FOWLER himself established in the work in question, were found in the material investigated by this writer and only females were found of both. The same stages were also found by me in material brought home by the „Michael Sars“ from the deep sea expedition of 1910. Both males and females were found. As I hope to be able to show in a subsequent work on the Ostracods of this expedition, these two stages represent in all probability the first and the second larval stages of *C. macrocheira* G. W. MÜLLER.* Because of this G. H. FOWLER's assumption that the last-mentioned species is „Stage I“ of *C. magna* C. CLAUS also collapses.

C. rotundata: — As is pointed out below (in a note on *C. rotundata*), it seems to me extremely probable that this species, as it is at present taken in the literature, is not a unit; it probably consists of two forms very closely related to each other, one of which has a somewhat more elongated shell than the other. This view is supported by the fact, among others, that the geographical distribution of these two forms does not seem to be the same; while both forms are found, for instance, in the Bay of Biscay and in the greater part of the Atlantic, only the more elongated form seems, on the other hand, to occur in the Antarctic. According to G. H. FOWLER's presentation the larvae of this species always belong to the short and high type. According to what I have observed myself the larvae of the elongated Antarctic form have about the same elongated type as the mature individuals. Elongated larvae are thus found. It does not seem to me impossible that these also occurred in the material investigated by G. H. FOWLER but were overlooked on account of their small number; one ought to note the great difference in number between elongated and short mature specimens in this material — the latter were very numerous, the former, on the other hand, very sparse. Finally it is to be noted that G. H. FOWLER did not succeed in „bringing out clearly the successive stages“ in the measurements taken by him to prove Brooks's law in this species. This fact too seems to indicate that the material was not pure from a systematic point of view.

C. spinirostris: — In the case of this species too it seems to me probable that a confusion has taken place between two very closely related forms. For the reasons in support of this view of mine I shall in this connection only refer to what I have written below, remarks on *C. spinirostris*.

C. Haddoni: — In the material investigated by G. H. FOWLER only two mature males of this species were found, both with shells 2,1 mm. long, and three male larvae, all with shells

* As can be seen from the following words G. H. FOWLER himself had a presentiment of the close relationship between „*C. zetesios*“ and *C. macrocheira*, he writes p. 254: „The species obviously belongs to the *magna* group. While the shell-contour to some extent resembles that of „*macrocheira*“, its frontal organ and the slender longer bristle of the inner joint of antenna II. are very far from the *magna-macrocheira* type; nor can it be fitted into the lengths which have been worked out for that series. It is remotely possible that it may be a dimorphic parthenogenetic form of *magna*, but parthenogenesis has not yet been shown to occur in the Halocyprids.“

1.0 mm. long. The mature specimens were assumed to belong to „Stage I", the three larvae to the last larval stage, „Stage III". The reason why the mature specimens were assumed to belong to „Stage I" was obviously the relatively great difference with regard to the length of the shells between these specimens and „Stage III"; these two stages were really presumably separated by an intermediate stage. The question then becomes: did the three larvae really belong to the last larval stage? Unfortunately the statements given are too incomplete for me to venture to say anything quite definite in this matter. It seems to me, however, from pl. XIX, fig. 77, very probable that these three specimens belonged to the next to the last larval stage. If this is the case, then the reason for assuming a mature stage between the stages found by G. H. FOWLER also disappears. On the other hand G. H. FOWLER found in this material two stages of mature females, „Stage I" being represented by seventeen specimens, „Stage II" by only three. Were both these stages mature? For the same reasons as in the case of the males it is very difficult for me to make any statement on this point, but it seems to me practically quite certain that the three specimens of „Stage II" were not mature; pl. XIX, fig. 80 definitely shows this. They were probably larvae in the last stage. If this is the case, there was in this sex too only one mature stage.

What has been said above will be sufficient to show clearly how uncertain is the basis on which G. H. FOWLER has constructed his important hypothesis.

Division of the family.

As is seen above, p. 564, this group was divided by G. W. MÜLLER, 1906 a, into two sub-families: *Thaumatocyprinae* and *Conchoecinae*. The same classification is also used in the present treatise. Of these two sub-families *Thaumatocyprinae*, which is so interesting from a systematic point of view, was unfortunately, however, quite unrepresented in the collections investigated by me.

Sub-Family Conchoecinae.

Sub-Fam. *Conchoecinae*, G. W. MÜLLER, 1906 a, p. 43.

Description: — S h e l l: — This is dimorphous, but in a number of cases only rather slightly so. — The rostral incisur is shallow in all species, but it never seems to be quite absent. An apparent deepening of the incisur occurs, however, in all the forms so far known. This deepening has arisen because the outer lamella of the shell curved out like a pocket just above the incisur, forming a rostrum which is in most cases rather extensive (this rostrum is thus not homologous with the part with the same name in the *Cypridiniformes*); the original anterior margin of the shell continues (as G. W. MÜLLER pointed out as early as 1894, p. 101) in the shape of a more or less S-shaped curved line („Buchtlinie", according to C. CLAUS's terminology) proximally on the inside, or perhaps more correctly speaking, on the ventral side of the rostrum. The rostral incisur is always situated above half the height of the shell, in most cases quite near its dorsal margin

The upper incisur lip never grows over the lower one. The sculpture of the surface is in most cases weak. The selvage is always lamelliform, in most cases well developed* both on the rostrum and along the anterior and ventral margins of the shell. It runs somewhat within and practically parallel with the ventral and posterior margins of the shell, being only slightly more distant from the margin posteriorly than it is anteriorly. It approaches more and more closely to the margin of the shell just beneath the rostral incisur and in the incisur it runs on the margin of the shell itself. On the rostrum the selvage runs on the „Buchtlinie“, i. e. on the original margin of the shell. The list runs from a point somewhat behind the rostral incisur in a uniform arcuation along and practically parallel to the ventral margin of the shell, somewhat inside the selvage; it has a whole margin and is in most cases very narrow, sometimes even difficult to establish with certainty. The inner line is in most cases very difficult to follow with certainty; it runs about parallel to the free margin of the shell somewhat inside the list. Close to the margin of the shell there always emerge very numerous glandular cells, which, as G. W. MÜLLER pointed out, 1906 a, may be conveniently divided into medial and lateral glands according to whether they emerge medially or laterally of the margin of the shell. A number of these glandular cells are concentrated in more or less large groups, which emerge with common pores or on a glandular field. Each shell has at least two such groups, one on each valve, each group with a single opening. As these two compound glands almost always have different positions on the two valves they were described by G. W. MÜLLER, 1906 a, as „die unsymmetrischen Drüsen“. In a number of forms (genus *Conchoecia*) there are, in addition to „die unsymmetrischen Drüsen“, two other compound glands developed; these are „die lateralen Eckdrüsen“ and „die dorsalen medialen Drüsen“, the former emerging with a single pore, the latter on a glandular field. „Die lateralen Eckdrüsen“ emerge on the right valve laterally of or close to and dorsally of the (right) „unsymmetrische Drüse“ and on the left valve about opposite to this place. „Die dorsalen medialen Eckdrüsen“ are two in number, one on each valve, and emerge symmetrically just ventrally of the postero-dorsal corner of the shell. There are very few glands on the surface of the shell. The joined part of the lamellae is in most cases narrow along the whole of the free margin of the shell. At or just in front of the postero-dorsal corner of the shell, just behind the joined edges of the hinge, there is often on the left valve a more or less powerful, oblong, hinge-tooth, and on the right valve a corresponding hinge-socket.

First antenna: — This has no or has more or less marked dimorphism. — It is moderately long or relatively short and varies in strength; the number of joints varies, but there are never more than five. Its (original) first joint is always without bristles. It is always furnished distally with a number of sensory bristles which are developed as thin-walled, hyaline, bare filaments, in most cases somewhat rounded distally. This limb is chiefly a sensory organ; it seems never to be used as a locomotory organ; in the case of the males it is often used for seizing the female.

Second antenna: — This always shows strong dimorphism; it is, as a rule, developed somewhat more powerfully in the male than in the female. — Exopodite: This is about the same in both sexes. The first joint has disto-ventrally a rather short and weak

* Cf. the remark on *Euconchoecia Chierchiae* below.

bristle. All the eight distal joints are short and differ rather slightly in length. Endopodite: This is relatively short; it has three joints in the male, and often two in the female, owing to the joining of the second and third joints. The end joint of this branch in the male is always situated at the side of (i. e. not distally on) the second joint and is in most cases bent like a hook (in exceptional cases, viz. in the genus *Euconchoecia*, this joint is straight on the left second antenna); on it one can often distinguish a proximal and a distal shank, which form a decided angle with each other; sometimes the distal shank is more or less distinctly bent at an angle. In the female this joint is exceedingly small, sometimes not perceptible, and, as has been pointed out above, often quite joined to the original second joint; the bristles that belong to it scarcely ever issue distally on the second joint but in most cases somewhat proximally of the bristles belonging to the original second joint (i. e. they have a position similar to that of the end joint on the male endopodite). The first joint has two short, pointed bristles of the ordinary type in both sexes. The bristles on the second joint vary somewhat in number, but there always seem to be two long bristles developed distally on the joint both in the male and the female. The third joint in the male always has three bristles. The same number is usually found in the female, only in exceptional cases (some species of the genus *Euconchoecia*) is there a smaller number in this sex. One or more of the bristles of the (original) second and third joints are developed, both in males and females, as sensory bristles. This branch is never used as a locomotory organ; the end joint is used in the males for seizing and holding fast the females.

Mandible: — This has rather weak dimorphism, sometimes even none at all. — Protopodite: Coxale: The pars incisiva is always furnished on the anterior side with a very powerful, more or less broadly triangular process, against which the endite on the following joint rests with an antero-inner edge (= „Zahnhöcker", according to C. CLAUS's terminology, 1891 a; see, for instance, p. 24). The pars incisiva is flattened distally and is cut off somewhat obliquely; its distal edge is armed with a number of teeth situated in a row (= „Zahnrand", according to C. CLAUS's terminology, 1891 a). Inside (or, more correctly speaking, dorsally of, when the limb is in a position of rest), about parallel to and somewhat proximally of this margin there are two tooth-lists joined fast to each other (= „Proximale und distale Zahnleiste", C. CLAUS, 1891 a) attached by a ginglymus joint; these tooth-lists are as a rule not quite as broad as the distal edge of the endite. Proximally of these tooth-lists the pars incisiva is furnished with a somewhat cushion-like masticatory process which varies very much in its development, sometimes being very small, but apparently never quite absent (= „Zahnplatte" or „Zahnwulst", C. CLAUS, 1891 a). In other respects the pars incisiva differs rather much in structure in different genera. This joint is quite without bristles except close to the masticatory cushion just mentioned on the pars incisiva. Basale: In most cases this is about as long as or rather slightly shorter or longer than the two following joints and somewhat higher posteriorly than it is anteriorly. The distal edge of the endite always has a row of six moderately large and in most cases powerful teeth, armed with secondary teeth; sometimes the number of these teeth is apparently increased because the main tooth is only slightly greater than its secondary teeth (cf. fig. 10 of *Conchoecia Gaussi* below). Behind these teeth there are two rather short, moderately strong processes, one situated somewhat behind the other; the anterior one of these is always of the tube-bristle

type (cf. the special terminology below), the posterior one is almost always more or less dagger-shaped, only in exceptional cases of the tube-bristle type. On the outside of this endite, somewhat proximally of nos. 1—3 of the teeth on the distal edge (counting from front to back) there is a solitary more or less well developed tooth. On the inside of this joint, somewhat proximally of the middle and about half way up the joint there is a powerfully chitinized, in most cases broadly triangular edge, against which the coxale rests. The number and positions of the bristles on this, as on the following joints, are subject to rather slight variation. The following number and positions were found on the basale on the species investigated by me. On the endite there were always four bristles; one of these was situated on the anterior edge of the process, about half way up the process or in most cases somewhat distally of this point, the three others on the outside of the process. In addition there was in most cases on the inside, near the distal boundary of this joint, a solitary bristle. The e p i p o d i a l a p p e n d a g e is, if it is developed, always small, verruciform, furnished with a single bristle and situated on the above-mentioned broadly triangular edge on the inside of the basale, against which the coxale rests. The e x o p o d i t e has always one bristle (in most cases plumous). E n d o p o d i t e: The proportion between the joints, which seems to be subject to rather slight variation, is shown by the following figures (taken from measurements of *Conchoecia symmetrica* G. W. MÜLLER, ♂):

$$\text{I : II : III} \quad \text{about } \tfrac{12}{7} : \tfrac{8}{4} : \tfrac{7}{5}.$$

Thus the second joint is relatively short, compared with this joint in the sub-order *Cypridiniformes*, the end joint, on the other hand, is comparatively large. The first joint is somewhat narrower proximally than it is distally, the end joint is often only rather slightly narrower than the first and second joints. The first joint has a single bristle antero-distally and a somewhat varying number of bristles posteriorly (from one to four were observed on the species of this sub-family that were investigated by me). The second joint has always three bristles antero-distally and two or one, in most cases two, only exceptionally *(Euconchoecia)* one, posteriorly. The end joint is always furnished with seven* distal bristles. All the bristles on the basale (except the two short processes behind the teeth of the distal edge on the endite) and the endopodite are of the ordinary type, not tube-bristles. On the inside of the end joint there emerges a more or less powerful gland. The exit of this gland is surrounded by numerous rather short and exceedingly fine hairs. Pilosity: On the basale there are a number, in most cases three or four, of transverse rows of rather short, stiff hairs posteriorly on the endite.

M a x i l l a: — This has no dimorphism or at any rate it is only scarcely perceptible. — P r o t o p o d i t e: The species of this sub-family investigated by me had the following numbers of bristles on the endites: The endite on the procoxale had from six to ten distal bristles, the endite on the coxale had from twelve to sixteen distal bristles. These bristles are subject to rather slight variation; about the same types are found at the corresponding places in all species; there is great constancy within the species. One or a few of the bristles on the endite of the procoxale are furnished with long, stiff secondary bristles; on the other hand there seem to be

* It may perhaps be of a certain interest to observe that the end joint of the 5th limb in the family *Cypridinidae* is characterized by the same number.

in most cases (always?) no such secondary bristles at all on the bristles of the endite of the coxale. Apart from these bristles the procoxale and the coxale are quite without bristles. The basale forms on the inside a somewhat lobe-like projecting part, furnished in most cases with a single bristle; apart from this the joint has no bristles at all. Endopodite: The first joint had in the species investigated by me from four to six bristles on the anterior edge and from two to four bristles at about the middle or somewhat distally of the middle of the posterior edge; in addition there is a single bristle on the inside of this joint somewhat distally of the middle or rather near the distal boundary. The end joint is armed with five or six distal bristles.

Fifth limb: — This has no dimorphism or at any rate it is scarcely perceptible. — Protopodite: The basale is furnished with traces of two endites. Epipodial plate: The number of the marginal bristles is almost quite constant within this whole group; the following numbers were observed on all the species investigated by me: five bristles in the proximal, five (four in only one species) in the middle and four in the distal group; in exceptional cases, however, an increase or a decrease of one bristle may be observed in one or more specimens in one or two of these groups. All these bristles are comparatively long, with long secondary hairs right out to their points, except the proximal one in the proximal group, which is only about as long as or somewhat shorter than half the length of the others, and has short, fine hairs. Exopodite: This has always three joints. Its first and second joints are rather elongated and of about the same length. First joint: This has a moderate number of bristles ventrally; there is only one bristle dorsally on the joint and it is in most cases very long; in addition there are laterally, at about or somewhat in front of the middle of the joint, in most cases one, sometimes two, bristles. Second joint: This has only three bristles, one of which is situated dorsally, at or somewhat in front of half the length of the joint, the two others close to each other at the corresponding place on the ventral side of the joint.

Sixth limb: — This is with or without dimorphism. — Epipodial plate: The number of marginal bristles seems to be almost quite constant within the whole of this sub-family. The following numbers were observed by me on all the species of this group that were investigated for this treatise: seven bristles in the proximal group, five in the middle one and five in the distal one. Just as in the case of this appendage on the preceding limb an increase or decrease of one bristle in one or two of these three groups may, however, be observed on single specimens. These bristles are of the same type and about the same length as those on the epipodial plate on the fifth limb; I ought perhaps to point out especially that, just as in the case of this plate, so, too, on the sixth limb the proximal bristle in the proximal group has short hairs and is relatively short, about as long or not quite as long as half the length of the other bristles. Endopodite: This has only one or two bristles. Exopodite: The three proximal joints are rather elongated and often of about the same length. The first joint has a moderate number of bristles ventrally, and in most cases one bristle dorso-distally. The second joint has only one, rarely two bristles, situated ventrally, in most cases at about half way along the joint. The third joint has in most cases two bristles, one of which is situated dorsally,

one ventrally,* at or somewhat distally of half the length of the joint; these two bristles are sometimes very much reduced in the male, sometimes one at least may even be quite absent.

Seventh limb: — This shows no dimorphism. — It varies so little in type that it did not seem to be necessary to reproduce it for more than one species, *Conchoecia symmetrica* G. W. MÜLLER. One of the two end bristles is rather long, the other is about half or not quite half the length of the former. Both are of the same type: flattened proximally, narrowing distally to a fine point; very flexible, but with a strengthening list along one side, on the proximal half of the bristle. This list is furnished with close, short, stiff hairs, arranged in two rows; these hairs are so fine that they are almost impossible to establish with certainty. These bristles are quite bare distally. The end joint is in most cases armed with fine hairs or spines, which are often difficult to observe with certainty. Apart from these this limb is bare.

Copulatory organ: — Unpaired. It issues on the left side** of the body just in front of the furca, but is bent so that its point is situated in most cases in or even somewhat to the right of the middle line of the body. It points obliquely forward and downward. It is very powerful and large, more or less oblong and flattened at the sides. Near its posterior edge runs the vas deferens, which emerges distally in a forward bending and in most cases strongly chitinized point near the distal point of the copulatory organ or a short distance proximally of it. A rod-shaped body penetrates into the vas deferens from the back. By means of special muscles at the base of the copulatory organ this body can be pressed forwards and backwards like the piston of a pump. In the middle part of the organ or in its distal half there is a rather powerful musculature developed; most of these muscles run obliquely across the organ.

Furca: — This has no dimorphism. — The lamellae are not sharply marked off from the body proximally, nor is there any furcal field developed. The somewhat arched posterior margin of the lamellae has a number of moderately strong or rather weak claws, in most cases weakly bent or almost straight; the anterior ones are moderately long, the others decrease rather uniformly and strongly in length the more posteriorly they are situated; there is no division into main claws and secondary claws. The number of claws seems to vary very slightly: seven or eight were observed on the species of this sub-family investigated by me. All the claws are well marked off proximally. The most anterior claw (called by a special name „Hakenborste" by C. CLAUS) is situated a little way up on the anterior edge of the lamella and is in most cases separated from the next anterior one by a somewhat greater distance than the distance between the other claws. The armature of the claws in the species of this sub-family investigated by me was as follows: The proximal part was often bare or only furnished posteriorly with a rather small number of weak spines; sometimes, however, like the distal part, it is closely and finely pectinated; this character is most frequently a variable one. Distally of this part each claw is armed posteriorly with two rows of close, conical, smooth, pointed spines, which are directed obliquely disto-posteriorly. These rows, one of which runs somewhat laterally and the other

* It is to be noted that G. W. MÜLLER, in fig. 13, pl. XXXII, 1906 a, has drawn two bristles at this point for „*Euconchoecia Chierchiae*" and TH. SCOTT has done the same in the case of *E. d'Arcy Thompson* (1909, pl. IV, fig. 10).

** G. W. MÜLLER states, both in 1894 and 1912, that the penis is situated on the right side of the body. In the latter work this writer has also given a wrong position to the exit of the receptaculum seminis and the oviduct; he writes (l. c. p. 53): „der unpaare Penis liegt rechts, die Begattungsöffnung links, die Mündung des Eileiters rechts."

somewhat medially on the claw, continue in most cases right out to the point of the claw and run together proximally in most cases in the way shown in fig. 34 of *Conchoecia symmetrica*. The proximal ones of these secondary spines are moderately strong or rather weak, the others diminish gradually in size and strength the more distally they are situated. The lamellae are often furnished with groups of rather short, rather soft or stiff hairs; on the other hand there are no spines and bristles at all. Behind the furcal claws there is often an unpaired, short-haired, rather weak, moderately long bristle.

Alimentary organs:* — These are subject to only rather slight variation in this group. Contrary to the *Cypridiniformes* there is always a very well defined atrium, which is fairly well closed below, in front and at the back. This atrium is bounded at the back exclusively by the somewhat rounded (when seen from below wedge-shaped; cf. fig. 35 of *Conchoecia symmetrica* in the present work) paragnates, which are always well developed. These have on the ventral side some, in most cases four, rows of fine hairs running almost parallel to each other and along the inner margin a row of hairs that are in most cases stiff and powerful. The paragnates are attached on each side of the weakly arched under lip. The upper lip is large and helmet-shaped and is attached to the under lip by means of chitinous lists. Between the upper lip and the paragnates there is on each side of the mouth a rather deep indentation; see fig. 36 of *Conchoecia symmetrica* below; the pars incisiva of the coxale of the mandible penetrates into this indentation; cf. G. W. MÜLLER, 1894, pl. 1, figs. 18 and 19. The postero-ventral part of the upper lip is somewhat lamelliform; cf. G. W. MÜLLER, 1894, pl. 37, fig. 28; the rather strongly chitinized back edge of this part varies rather considerably in type in the different genera, but is always furnished on both sides on the middle part with a row of more or less powerful hairs. The inside of this part has at about the middle two transverse rows of stiff and rather powerful hairs and groups of short and exceedingly fine hairs. On the ventral side of the upper lip numerous unicellular glands emerge, the glands of the upper lip; cf. G. W. MÜLLER, 1894, pl. 37, fig. 28; in addition there is a gland, in most cases extensive, with its exit in the atrium; cf. the figure just mentioned. The oesophagus is rather long, with strong muscles, and is bent evenly and moderately strongly backwards; see G. W. MÜLLER, 1894, pl. 35, fig. 16. The stomach is large, oval and is furnished on each side of the aperture of the oesophagus with a rounded or rather elongated hepatic appendage, the lumen of which opens into the stomach with a rather narrow canal. The rectum is very short and emerges in front of the furca. No parts of the digestive organs ever penetrate between the lamellae of the shell.

Sexual organs: — Male: — The testes are paired, consisting of two bag-shaped oval bodies. From each of these there issues a rather short canal, the vas deferens, which is very much widened in mature specimens and which is often even more voluminous than the testes; cf. G. W. MÜLLER, 1894, pl. 38, fig. 19. The vasa deferentia are joined inside the penis to an unpaired passage, which continues into the penis and emerges at its point. Female: — The ovaries, like the testes, are paired and are situated posteriorly in the body;

* The description of these organs given in this work is for the most part taken from G. W. MÜLLER's large monograph, 1894 (pp. 119 and 120). This description, which seems to be satisfactory in a treatment of the systematization of this group, must, however, be added to fairly considerably. I hope to have an opportunity of giving a detailed description of the structure and mechanism of these organs in a subsequent work.

in young individuals they are bag-shaped, in mature ones they are shaped like a bunch of grapes; cf. G. W. MÜLLER, 1894, pl. 40, fig. 14; they pass gradually into the o v i d u c t s. These soon join to an unpaired passage, which is in most cases furnished distally with an extension and has its exit on the left side of the body just in front of the furca. This exit, a narrow fissure, always seems to be without chitinous thickenings and is very difficult to observe with certainty except in series of sections. Only one r e c e p t a c u l u m s e m i n i s is developed. This, whose outer exit is to be found at about the place corresponding to that of the right receptaculum in *Cypridiniformes*, extends transversely across the back of the body and has its exit in the oviduct on the left side of the body; cf. G. W. MÜLLER, 1894, pl. 38, fig. 58. No parts of the sexual organs ever penetrate between the lamellae of the shell.

The h e a r t is always developed.

R o d - s h a p e d o r g a n:* — This is sometimes with, sometimes without dimorphism. — It is always developed, in most cases comparatively long and rod-shaped. (Only in a single one of the species so far known, *Euconchoecia lacunosa* G. W. MÜLLER, is it possibly very short; it is not improbable, however, that this is a mistake: „Frontalorgan des ♀ auf einen kurzen Zapfen reduziert (?)", G. W. MÜLLER, 1908, p. 80.) It is attached high up on the forehead and in most cases points directly forward. It varies rather considerably in type.

Special terminology: — S h e l l: — With regard to the glands I have used the terminology worked out by G. W. MÜLLER (1906 a). Thus „die unsymmetrischen Drüsen" (= „Rückendrüse +" „untere Hinterrandsdrüse", according to C. CLAUS's terminology, 1891 a) are called „the unsymmetrical glands"; „die lateralen Eckdrüsen" are called „the lateral corner glands" and „die dorsalen medialen Drüsen" (= „oberen Hinterrandsdrüsen", according to C. CLAUS's terminology, 1891 a) are called „the dorso-medial glands".

S e c o n d a n t e n n a: — In the case of the bristles on the endopodite the following alphabetical notation has been used in the descriptions of the species: The two bristles on the first joint = the a- and the b-bristle, the proximal one being the a-bristle. Second joint: The two long distal bristles = the f- and the g-bristle; the little bristle just near the base of these in a number of species (of *Conchoecia*) = the e-bristle, the two bristles, in most cases short — also occurring only in a number of forms, e. g. males of *Conchoecia* — somewhat proximally of these = the c- and d-bristles, the c-bristle being the more proximal one. The three bristles of the end joint are called the h-, i- and j-bristles.

M a n d i b l e: — With regard to this limb I have used, on the whole, the terminology introduced by C. CLAUS: Coxale: The „Zahnhöcker", according to C. CLAUS's terminology, on the anterior side of the pars incisiva is called „the hump". The „Zahnrand" on this process

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* In the present work mention is made of jointed and unjointed rod-shaped organs. In this I follow the example of G. W. MÜLLER. On the other hand C. CLAUS, 1891 a, p. 19, states that there are no real joints here: „Die oft scharf ausgeprägte Absetzung des eichelförmigen Vorderabschnitts beruht lediglich auf einer Knickung, hat aber weder mit einer Articulation etwas zu thun, noch kann sie als eine bewegliche bezeichnet werden" (G. W. MÜLLER uses the word „beweglich"), „da derselben Muskeln fehlen". It is certainly true that the different segments are not furnished with muscles, but they sometimes possess very great passive mobility. It seems to be wrong to limit the conception of a joint to those cases in which the segments are moved by special muscles.

is translated by „the toothed edge". The „proximale und distale Zahnleiste" = „the proximal and distal tooth lists". The „Zahnplatte" or „Zahnwulst" is called in the present work „the masticatory pad".

This terminology differs in a number of respects from that used by G. W. MÜLLER. Thus this investigator calls (1890 a) „the toothed edge" and the two tooth-lists sometimes the first, second and third, sometimes the third, second and first „Zahnleiste"; cf. pl. XXVIII, figs. 18 and 20. In this investigator's work of 1894 these parts are similarly called „Zahnleiste", but they are not enumerated. In the genus *Conchoecia* „the masticatory pad" is divided into two more or less well differentiated parts; the distal one of these is called by G. W. MÜLLER „Zahn", the proximal one „Wulst", both in his work of 1890 a and in his large monograph.

In the present work the term t u b e - b r i s t l e is given to a distally blunt (somewhat rounded) bristle with — in comparison to the side-walls — an exceedingly thin-walled distal point; on account of this structural peculiarity bristles of this type have a somewhat tube-like appearance, whence the name tube-bristle. The point of a bristle of this sort is, when seen from the side, almost always furnished with two exceedingly short and fine points. (Only apparently? Do these two spines correspond to a closed ring? On account of the smallness of these forms I have not been able to decide this question with certainty. It does not, however, seem absolutely impossible.) No terminus tecnicus has so far been found for this type of bristle, as this peculiarity of structure has not been observed by previous writers.

U p p e r l i p: — The two comb-like parts of the postero-ventral edge of the upper lip, which are furnished with a row of more or less powerful hairs, are called below simply the combs of the upper lip.

Which genus of this sub-family is the most primitive?

Remarks: — Which of the four genera belonging to this sub-family is to be considered as the most primitive? It must be admitted that this question is exceedingly difficult, not to say impossible, to answer at present. They are all variations of the same theme and the variations are not profound. In this matter I have nothing to add to what has been said by G. W. MÜLLER, 1894, pp. 223 and 224.

Transitional forms between the genera.

No transitional forms between these genera are known. It is true that there are statements about such forms, but these are only due to lack of knowledge about the forms in this group; as an example I may mention J. LUBBOCK's statement (1856, p. 34) that *Conchoecia atlantica* (LUBB.) is an intermediate form between the genera *Conchoecia* and *Halocypris*.

Number of the joints of the first antenna in Conchoecia and Halocypris.

There has been a certain amount of difference of opinion as to the explanation of the joints of the first antenna in the genera *Conchoecia* and *Halocypris*.

With regard to the first antenna of the males of the genus *Conchoecia* we find the following statements in the literature: G. O. SARS writes 1865, p. 116: „antennae superiores . . . . in mare . . . . distincte 4 articulatae". In this writer's work of 1887 it is pointed out (p. 71) that this antenna is composed of „5 tydeligt begraendsede Led", i. e. of five distinctly defined joints. — In C. CLAUS's work of 1874 b, we find (p. 10): „der Endabschnitt besteht auch nur aus zwei Gliedern, neben denen freilich der obere ringförmig abgesetzte Theil des zweiten Schaftgliedes den Eindruck eines dritten Gliedes macht"; thus according to this view this antenna

has four joints. According to this writer's work of 1891 a, p. 21, on the other hand, this antenna has five joints: it consists of „einen zweigliedrigen, stielförmigen Schaft und eine dreigliedrige Geißel". — In G. W. MÜLLER's work of 1890 a this antenna is stated (p. 258) to have five joints; according to the same investigator's work of 1894, p. 25, on the other hand, it has only four joints, but it was pointed out that sometimes „noch ein 3. kleines Glied am Ende des Stammes mehr oder weniger deutlich abgegrenzt ist"; in his work of 1912 G. W. MÜLLER gives four as the number of joints in this antenna.

We find the same differences with regard to this antenna in the genus *Halocypris*.

All these authors have obviously fluctuated between two alternatives: a four-jointed or a five-jointed first antenna; by the two former authors the latter alternative was adopted; in G. W. MÜLLER's later works, on the other hand, the former alternative prevailed.

The question at issue is clearly whether the little collar-like part distally of the second joint ought to be counted as a special joint or if it ought to be taken as a part of the second joint. Which explanation is correct? It seems to me that it is almost a matter of taste. In all the species of the above-mentioned two genera that I investigated this part had no special muscles at all, no muscles are limited to it and none are attached on its proximal boundary. I have nevertheless taken it as a special joint in this work. This is due to the fact that in a number of forms it is exceedingly well marked off; cf., for instance, fig. 8 of *Halocypris brevirostris*. I could not find any guidance towards the solution of this problem from the third genus of this family *Euconchoecia* that I had an opportunity of investigating.

Homologization of the joints of the first antenna.

Is it possible to carry out a quite certain homologization of the joints of the first antenna in the genera belonging to the *Conchoecinae*?

In the case of the genera *Halocypris* and *Conchoecia* these joints may with great certainty be homologized. — The highest number of joints on the first antenna in the latter genus is five, and there does not seem to be the least doubt that these joints are homologous to the five joints that characterize in most cases this antenna in *Halocypris*. This assumption is supported both by the bristles and the musculature of this limb.

The number of bristles is, as we know, quite the same in these two genera: the first and third joints have no bristles at all, the second joint has a single bristle dorsally and the fourth* and fifth bristles have two and three bristles respectively. In addition these bristles are of about the same type in the genus *Halocypris* as in the females of *Conchoecia*.

All the species of *Conchoecia* investigated and described by me below have a practically identical muscular system in this antenna. It is true that slight exceptions from the type described below can be observed, but these are of no importance for this question, so that they are not mentioned here. In the males of this genus we find the following muscles in this antenna (type: *C. symmetrica* G. W. MÜLLER; cf. fig. 7 of this species): The first joint contains two muscles. One of these, the extensor of the second joint, is very strong, simple, and has the nature of almost a pure extensor; proximally it is attached dorso-proximally on the first joint, distally on the second joint dorso-proximally, somewhat laterally. The other of these two muscles is also strong, in most cases divided into two (only exceptionally into more) well defined parts,

* With regard to a larger number of bristles in *Conchoecia serrulata* see the remark on this species below.

which are attached close to each other both proximally and distally; one part is situated somewhat dorsally of the other on the medial side of the limb; this muscle is attached proximally somewhat in front of the ventral half of the proximal boundary of the first joint, distally on the proximal boundary of the second joint, at about half the height of this joint. (This muscle seems to move the second joint straight inward.) In passing I wish to mention that the distal attachments of two muscles are to be found proximally on the first joint. — The second joint has the following four muscles: The flexor of the fourth joint, a very powerful muscle, and, as far as I could ascertain, purely of a flexor nature; it is in most cases divided into two parts; the more powerful part, the ventral one, is proximally attached ventero-proximally on the second joint, the weaker part has its proximal attachment proximo-medially on this joint about half way up it. Dorsally in this joint there is a very powerful muscle with its proximal attachment dorso-proximally on the joint and attached distally on the proximo-medial boundary of and at about or somewhat above half the height of the fourth joint. A smaller part of this muscle is often proximally attached about half way along the second joint, dorsally. (This muscle seems to move the fourth joint inward and somewhat dorsally.) A rather short and moderately strong muscle runs on the medial side of the second joint, with its distal attachment dorso-proximally on the fourth joint and its proximal attachment a rather short distance proximally of the distal boundary of the second joint, at or somewhat ventrally of half the height of this joint. Finally we find on this joint the flexor of the fifth joint, a moderately strong muscle, presumably of a purely flexor nature, perhaps moving the fifth joint a little inward too; its proximal attachment is proximo-medially on the second joint, at about half the height of this joint, its distal attachment ventrally (perhaps somewhat medially) on the proximal boundary of the fifth joint. — There is no special muscle in the third joint. — In the fourth joint there is a single muscle; it is very short, but rather powerful; its proximal attachment is about at or somewhat proximally of the middle of the dorsal side of this joint, its distal attachment on the proximal boundary of the fifth joint, ventrally and somewhat laterally of the former flexor of this joint. — We find the same muscles in this antenna of the females of this genus, but the flexor of the fourth joint is divided in the second joint into two parts, one of which is proximally attached ventrally on the second joint at about or somewhat proximally of half the length of this joint. The muscle of the fourth joint that has its proximal attachment proximo-dorsally on the second joint is simple. (All the muscles are weaker than those of the male.)

In the genus *Halocypris* we find all these muscles in the first antenna, with only small divergencies. It is to be noted, however, that the muscle of the fourth joint that is characterized in *Conchoecia* by being very short, with its proximal attachment a rather short distance proximally of the distal boundary of the second joint, runs near the l a t e r a l side of the limb in the genus *Halocypris*. For other details the reader may compare fig. 7 of *Conchoecia symmetrica* with fig. 8 of *Halocypris brevirostris*.

The state of affairs in the first antenna of the genus *Euconchoecia* is considerably more complicated. In this genus too the highest number of joints found in this limb is five; cf. this genus below. Yet it seems impossible — at least at present — to say that these joints are homologous with the five joints on this antenna in the genera *Halocypris* and *Conchoecia*. In

the former genus this antenna does not bear any close resemblance to the two latter genera either in its bristles or its musculature.

The first, second and third joints of both the male and female first antennae in the genus *Euconchoecia* are quite without bristles. The fourth joint of this antenna has ventrally in both sexes a large number (about twenty or more) of sensory filaments of the same type as the two sensory filaments on the next to the distal joint of the first antenna in the genus *Halocypris*. The end joint has four or five bristles on the male first antenna, and a somewhat smaller number in the female (in most cases one bristle less than in the male?). It seems at present to be quite impossible to carry out a homologization between the bristles on the two distal joints in the genus *Euconchoecia* on the one hand and those of *Halocypris-Conchoecia* on the other.

In the genus *Euconchoecia* this antenna is characterized by the following muscles: Male (type *E. Chierchiae*; cf. the accompanying fig. 12 of this species): First joint: Three muscles penetrate from the body into this antenna; two of these run ventrally and one dorsally in the first joint; they are all moderately strong. The dorsal one of these three muscles is attached distally dorso-medially on the proximal boundary of the second joint — the extensor of the second joint. Of the two ventral ones one has its distal attachment proximo-ventrally on the second joint, the other at the corresponding place on the third joint — the flexors of the second and third joints. Besides these three there are two more muscles in the first joint, an extensor for the second joint and a flexor for the fourth joint. The former of these two muscles is moderately strong and has its proximal attachment proximo-dorsally in the first joint and its distal attachment on the proximal boundary of the second joint, dorso-laterally. The latter of these two muscles is very strong and has its proximal attachment on the medial side of the first joint at about half the height of this joint, somewhat proximally of the middle; distally it is attached at the proximo-ventral corner of the fourth joint. — The second joint has two muscles, both of which are powerful. One of these has its proximal attachment proximo-dorsally and laterally in this joint, and its distal attachment on the proximal boundary of the third joint, dorso-laterally. The other is proximally attached on the proximal boundary of the second joint, medially, at about half the height of the joint; its distal attachment is on on the proximal boundary of the third joint, medially somewhat ventrally of half the height of the joint. (The former of these two muscles seems to move the third joint outward and upward, the other moves the same joint downward and inward.) — Third joint: Ventrally in this joint there is a moderately strong muscle, proximally attached proximo-ventrally in this joint, distally at the proximo-ventral corner of the fourth joint — the flexor of the fourth joint. Dorso-proximally in the third joint there is attached the extensor of the fifth joint, a powerful muscle with its distal attachment at the dorso-proximal corner of the fifth joint. In addition there are in the third joint two rather strong muscles, one medial, the other lateral, with their proximal attachments near the proximal attachment of the extensor of the fifth joint and their distal attachments medially and laterally respectively on the proximal boundary of the fourth joint at or somewhat dorsally of half the height of this joint. (These two muscles, which are, for practical reasons, only indicated in the accompanying figure 12 of *E. Chierchiae*, seem to move the fourth joint inward and outward respectively and somewhat upward.) — The fourth joint has only one muscle, the

flexor of the fifth joint. This is very powerful, and has its proximal attachment dorso-proximally, somewhat laterally, in the fourth joint and its distal attachment at the ventral corner of the fifth joint. — The female first antenna in this genus has a muscular system of about the same type as that described for the male, but all the muscles are very weak, and some of them are even quite absent.

The descriptions given above will show that it is impossible to find between the muscular system of the first antenna in the genus *Euconchoecia* on the one hand and the genera *Halocypris-Conchoecia* on the other agreements of such a nature as to permit of a quite certain homologization being carried out between the joints of this antenna in these two groups.

I cannot state anything very certain about the homologization of the joints of the first antenna in the genus *Archiconchoecia*. — With regard to the numbers and positions of the bristles this antenna shows a considerably greater resemblance to *Halocypris* and *Conchoecia* than the corresponding limb in the genus *Euconchoecia* does. Thus the second joint has a single bristle dorsally and the next to the distal joint has two bristles of about the same type as the bristles on the corresponding joints in the genus *Halocypris*. The end joint has five bristles, i. e. the same number as in the genus *Euconchoecia*. Does this fact indicate that the bristles of this joint (and the end joint itself?) are homologous in the genera *Archiconchoecia* and *Euconchoecia*, and that the two sensorial filaments on the next to the distal joint on this limb in the former genus (and in the genera *Halocypris* and *Conchoecia*?) correspond to the great number of similar sensorial filaments on the next to the distal joint of the first antenna in the genus *Euconchoecia*? This does not seem to me impossible. The muscular system in this antenna in the genus *Archiconchoecia* is unknown; I cannot describe it myself owing to lack of material. It cannot therefore be produced here to help solve this problem.

It is, of course, impossible at present to homologize the joints of the first antenna in this sub-family with the joints on the corresponding limb in the other sub-orders. Neither the bristles nor the muscular systems in any of the forms so far known in detail seem to afford any support for a solution of this problem. A closer investigation of this antenna in the genus *Thaumatocypris* would, however, be interesting as throwing light on this question.

Number of joints on the exopodite of the second antenna.

As is seen above, I have established the presence of nine joints on the exopodite of this limb. This number was already given by C. CLAUS, e. g. 1891 a, p. 22. G. W. MÜLLER, on the other hand, always gives only eight joints for this branch (cf. this writer, 1894, p. 37, 1906 a, p. 30).

Five joints on the endopodite of the second antenna.

With regard to the appendage on the endopodite of this limb for seizing and holding fast the female I have followed G. W. MÜLLER; in other words this appendage has been explained in the present work as the distal joint of the endopodite. — C. CLAUS took another view of this problem. According to him the distal part of the second joint (according to G. W. MÜLLER's explanation), i. e. the part that has the f- and g-bristles, corresponds to the end joint of the endopodite, and the clasping organ is an accessory appendage on the original second joint. Other writers do not express any quite distinct opinion in this question, but they seem, as a rule, to have inclined to C. CLAUS's view. — Both G. W. MÜLLER and C. CLAUS take up a very decided position in this question. The problem seems to me, however, exceedingly difficult to decide

at present. C. CLAUS's view seems to be supported by the fact that the part on which the f- and g-bristles are attached almost always composes the distal part of the second joint; thus in the male the clasping organ issues on the side of and not distally on this joint and in the female these two bristles issue in most cases distally of the h-, i- and j-bristles. In addition in the male this part on which the f- and g-bristles are attached is often somewhat contracted proximally, so that it gets a somewhat joint-like appearance (cf. fig. 13 of *Conchoecia symmetrica* below). G. W. MÜLLER's view seems to me to be supported by the following facts. The part on which the f- and g-bristles are attached is never, either in males or females, marked off proximally and is never moved by special muscles; on the contrary it is quite immoveably joined to the second joint. This is, of course, not a conclusive proof. Complete union between originally well divided joints is, of course, far from being rare in the Ostracod group. (But it seemed to be conclusive for G. W. MÜLLER, as this investigator writes, 1894, p. 38: „Einschnürungen sind noch keine Grenzen. So deutlich die Ansicht von CLAUS aus den Figuren ersichtlich sein mag, so kann ich doch auf eine Discussion dieser Figuren erst eingehen, wenn die Grenzen der Glieder scharf gezeichnet sind".) Besides, the appendage explained by G. W. MÜLLER as an end joint is well marked off proximally in the males and is moved by a special muscle. This is not conclusive evidence, either; accessory appendages that are well defined proximally and furnished with special muscles are found, of course, pretty often, e. g. the epipodial appendage, etc. (In [all?] males of the genus *Euconchoecia* the part explained by G. W. MÜLLER as the end joint has the form of a simple cylindrical joint with bristles distally on the left second antenna. Is this primitive or secondary? The latter alternative seems to me the more probable.) The fact which seems to me to afford perhaps the most decisive proof in favour of G. W. MÜLLER's view is that in the females of the genus *Halocypris* (the genus put forward by C. CLAUS in support of his view!) and in a number of females in the genus *Conchoecia* the part on which the h-, i- and j-bristles are attached is always distinctly defined proximally and that it is moved by a special muscle; see fig. 12 of *Halocypris brevirostris* below (even in forms of the genus *Conchoecia* in which this part is quite joined to the second joint this muscle is more or less developed).

Genus Halocypris J. D. DANA.

For synonymy see G. W. MÜLLER, 1912, p. 57.

Description: — Shell: — Always very short, its height being at least two-thirds of its length. The rostrum is short, sometimes it is even scarcely developed at all. Of the two unsymmetrical glands the left one opens out just in front of the postero-dorsal corner of the shell, the right one at about the boundary between the ventral and posterior margins of the shell; sometimes, however, the latter gland is somewhat displaced dorsally. Apart from these there are no great accumulations of glands at all. The pores of the surface are moderately large and easy to observe. The part of the selvage that runs within the rostrum has no spine.

First antenna: — This shows no or only rather slight dimorphism. — It is rather short and moderately strong, growing gradually narrower distally. The two distal joints are in most cases rather strongly bent downwards and in most cases too the second joint forms, with the first, a rather distinct and ventrally open knee. The second joint has dorsally a single pointed bristle of the ordinary type. The next distal joint has two, the end joint three, long bristles; apart from these this antenna is quite without bristles. Of the five bristles on the two distal joints the distal (anterior) one on the end joint is longer and has, at least proximally, somewhat thicker walls than the others. In the male this bristle does not or at any rate not to any extent co-operate in seizing the female; it has both in the male and the female the same armature as in most cases characterizes this bristle in the females of the genus *Conchoecia*, i. e. it has a greater or less number of short hairs along the posterior side at or in most cases somewhat distally of the middle. The four remaining bristles on the two distal joints are most frequently subequal and are differentiated as thin-walled, bare, rather narrow sensory filaments, of about equal thickness throughout their whole length.

Second antenna: —

Male: — The protopodite has a verruciform appendage distally-laterally. (It is to be noted, however, that this character is not known in most of the species of this genus.) Exopodite: The first joint is of about the same thickness throughout its whole length. Endopodite: The first joint is moderately large, more or less square with rounded corners, without the processus mammillaris. The second joint is rather short, but powerful. It is always armed with four bristles, namely the c-, d-, f- and g-bristles; the e-bristle always seems to be absent. Of these bristles the c- and d-bristles are rather short and weak, pointed and of the ordinary type. The f- and g-bristles, on the other hand, are comparatively long, the g-bristle is always longer than the f-bristle; they are both rather powerful proximally, hyaline distally and obviously function as sensory organs. The proximal shank of the clasping arm of the end joint is short, especially on the left second antenna, the distal one, on the other hand, is rather long. The three bristles on this joint, the h-, i- and j-bristles, are subequal, always shorter than the f- and g-bristles; they are developed as hyaline, thin-walled, uniformly thick filaments and are attached at or somewhat proximally of the boundary between the proximal and distal shanks of the clasping arm.

Female: — The protopodite is similar to that of the male. Endopodite: This has three joints (always?). The first joint is about the same as that of the male, only slightly weaker. The second also is similar to that of the male, but it has only two bristles; the c- and d-bristles are absent; the f- and g-bristles are (always?) the same as in the male. The end joint is very short, but (at least in some cases) is distinctly marked off from the second joint*; it is fixed a rather long distance proximally on the latter joint; it has three bristles, which are (always?) quite or almost quite identical with those of the male. There is a low peg between two of these three bristles (for the morphological value of this process see the remark below under this genus).

The mandible, maxilla, fifth, sixth and seventh limbs, penis, furca and lips are so incompletely known in most of the species of this genus that have so far been

* Not observed by previous writers.

described that it did not seem to me convenient to include them in the diagnosis of the genus. In any case the result would be too uncertain to have any value. For these organs I refer to the description of *H. brevirostris* given below. I need only state here that (as C. CLAUS has pointed out) the basale on the mandible is relatively short, somewhat shorter than the total length of the first and second endopodite joints, and is armed with a very powerful endite which occupies almost the whole ventral side of this joint. In addition the sixth limb is characterized by its complete or almost complete resemblance in males and females.

The rod-shaped organ is similar or almost similar in both sexes. — It is moderately long, in most cases bent in a distinct angle; the part situated distally of the knee is longer than the proximal part. Otherwise it varies in type.

Special terminology: — First antenna: — The proximal one of the two bristles on the next to the distal joint is called in the present work the a-bristle and the distal one the b-bristle. Of the three bristles on the end joint the proximal one is called the c-bristle, the middle one the d- and the distal one the e-bristle. (The e-bristle is the one previously termed by C. CLAUS „Hauptborste“ or „Terminalborste“, by G. W. MÜLLER „Hauptborste“.)

Mandible: — The bristles on the pars incisiva of the first protopodite joint of this limb, which were called „Stachelzähne“ by C. CLAUS and G. W. MÜLLER, have been called „lancet-bristles“ in the present work.

Number of species.

Remarks: — Five species of this genus have been described (apart from the great number of synonyms). These are:

Halocypris globosa (C. CLAUS, 1874 a, p. 178), C. CLAUS, 1891 a, p. 79; pl. XXII, figs. 13—18.
„ *striata*, G. W. MÜLLER, 1906 a, p. 47; pl. VIII, figs. 20—23.
„ *cornuta*, „ „ „ 1906 a, p. 48; pl. V, figs. 8, 9; pl. VIII, figs. 1—7.
„ *bicornis*, „ „ „ 1906 a, p. 49; pl. VIII, figs. 8—12, 17.
„ *brevirostris* (J. D. DANA), cf. below.

Relations of these forms.

It is unfortunately impossible to give any detailed account of the relative positions of these forms, as the descriptions of the species so far worked out are too incomplete to permit of a detailed comparison between the forms. The best known are *H. globosa* and *H. brevirostris*. These species were given by C. CLAUS, 1874 a, as representatives of the genera *Halocypria* and *Halocypris* respectively. This classification is retained by this writer in all his following works; his example was also followed by a number of other writers, e. g. G. W. MÜLLER, 1890 a, G. S. BRADY and A. M. NORMAN, 1896, G. S. BRADY, 1897. V. VÁVRA, 1906, is inconsistent in this matter; on p. 62 he accepts this classification, but afterwards he only uses the genus name *Halocypris*. The only writer who has definitely rejected this classification is G. W. MÜLLER; in his works of 1894, 1906 a, 1908 and 1912 he groups these two species together into one genus, *Halocypris*.

It is certainly very futile, as G. W. MÜLLER pointed out in this connection (1894, p. 223), to discuss whether we are justified or not in establishing a genus, as this question is, of course, quite a matter of taste, but all the same it seems to me beyond doubt that this method of pro-

cedure adopted by G. W. MÜLLER is quite correct. The characters on which C. CLAUS chiefly based the genus *Halocypria*, the different development of the rostrum of the shell and of the masticatory pad and the lancet bristles on the coxale of the mandible, seem to me to be of so slight a nature that they constitute quite insufficient grounds for this classification.

As is seen from the description given above there is on the end joint of the endopodite of the female second antenna a peg-like little process between two of the bristles on this joint (more exactly between the h- and i-bristles). This process, which certainly corresponds to the similarly situated peg- or bristle-like appendage on the female second antenna in a number of species of the genus *Conchoecia* (see, for instance, my fig. 8 of *C. elegans*) is noteworthy because it has no homologon in the mature males. On the other hand it is often found in male larvae of Stage I. The size and shape of this process makes one inclined, of course, to homologize it with the e-bristles (cf. the genus *Conchoecia*); a closer investigation shows, however, that these appendages have quite different positions. The first is, as is mentioned above, situated between the h- and i-bristles, i. e. on the original third joint, the e-bristle is situated basally-anteriorly of the f-bristle, i. e. on the original second joint. I wish to point out in this connection the little process situated proximo-anteriorly of the f-bristle in my figure 9 of *C. elegans*, ♂ juvenis in Stage I; this process certainly corresponds to the e-bristle in the mature males. In this species there is also at this stage a little process between the h- and i-bristles, which is of about the same type as in the mature females. The same figure also shows that this process cannot be homologous to the c- or d-bristles, which would, of course, be exceedingly improbable, because these two bristles, like the e-bristle, belong to the original second joint.

Halocypris brevirostris (J. D. DANA).

? *Conchoecia brevirostris* + *C. inflata*, J. D. DANA, 1849, p. 52.
? *Halocypris inflata* + *H. brevirostris*, J. D. DANA, 1852, pp. 1301 and 1303; pl. XCI, figs. 8 and 9.
,, *brevirostris* + *H. Toynbeeana*, J. LUBBOCK, 1860, p. 16 (188) and 17 (189); pl. XXIX, figs. 35—39.
,, *concha*, C. CLAUS, 1874 a, p. 177.
,, ,, ,, ,, 1874 b, p. 7; pl. II, figs. 20—25, pl. III, figs. 26—35.
,, *brevirostris*, G. S. BRADY, 1880, p. 166; pl. XXXIX, figs. 1—11.
,, *concha* + *H. pelagica* + *H. distincta*, C. CLAUS, 1890, pp. 24 and 25.
,, *dubia* + var. *major*, G. W. MÜLLER, 1890 a, p. 269; pl. XXVIII, figs. 19, 23, 24, 30, 35.
,, *concha* + *H. pelagica*, C. CLAUS, 1891 a, pp. 77 and 78; pl. VIII, fig. 12; pl. XI, figs. 6, 7; pl. XXI, figs. 1—11; pl. XXII, figs. 1—12; pl. XXIV, figs. 6—20 and pl. XXVI, fig. 1*.

* In the explanation of pl. XXVI this species is named *Halocypris atlantica*.

Halocypris concha + *H. pelagica*, G. S. BRADY and A. M. NORMAN, 1896, pp. 702, 703; pl. LXII, figs. 14—19.

„ „ „ „ „ G. S. BRADY, 1897, p. 77.

„ *concha*, A. SCOTT, 1905, p. 370.

„ *pelagica*, P. T. CLEVE, 1905, p. 131.

„ *inflata*, G. W. MÜLLER, 1906 a, p. 50; pl. VII, figs. 19—28.

„ „ „ „ „ 1906 b, p. 2.

„ *concha* + *H. pelagica*, V. VÁVRA, 1906, pp. 63 and 64.

„ „ „ „ „ CH. JUDAY, 1906, p. 27; pl. VII, figs. 4—7.

„ *inflata*, G. W. MÜLLER, 1908, p. 65.

„ „ + *H. globosa*, TH. SCOTT, 1912 a, p. 587; pl. XIII, figs. 29—32.

„ „ G. W. MÜLLER, 1912, p. 58.

Description: — See C. CLAUS, 1891 a, pp. 77, 78 and G. W. MÜLLER, 1906 a, p. 50.

Supplementary description: — Male: —

Shell: — The length varies, according to G. W. MÜLLER, 1906 a, between 1,15 and 1,75 mm. Of the mature males investigated by me 29 (from ten different stations) had shells from 1,4—1,6 mm. long; thus in these specimens this character was subject to rather slight variation; one specimen, from S. A. E. station 116, only attained, however, a length of 0,95 mm.; with regard to the latter specimen see p. 598 below. Length : height about 1,45 : 1; length: breadth, about 1,65 : 1. Seen from the side (see the accompanying fig. 1), it has generally the same type as observed by G. W. MÜLLER; cf. this writer, 1906 a, pl. VII, fig. 20. The little male from station 116 was, as is shown in fig. 2, of a somewhat different type. Transitional forms between these types were found. Seen from beneath the shell is very broad and lentil-shaped, with its greatest breadth somewhat in front of the middle; the side contours are well and uniformly rounded and the rather well rounded anterior and posterior ends are of about the same size. Seen from behind (fig. 5, ♂ = ♀) it is somewhat heart-shaped, as the dorsal margin is slightly concave. The sculpture of the surface of the shell is as described by G. W. MÜLLER; rather sparse short hairs were observed on the surface of the shell. Seen from inside: The hinge was of about the same type as is reproduced in pl. XXII, figs. 1, 2 and 3, C. CLAUS, 1891 a. The selvage is rather broad along the anterior and ventral margins of the shell (ventrally of the incisur and along the anterior and middle part of the ventral margin of the shell the selvage is so broad that when the shell is pressed beneath the coverglass, it extends somewhat beyond the margin of the shell), it becomes more and more narrow posteriorly until it ceases altogether at about the boundary between the ventral and posterior margins of the shell or somewhat more dorsally, sometimes it continues up along the posterior margin of the shell to about half the height of the shell. On the anterior half of the shell — and on the rostrum too — the selvage has a smooth edge; from a point at or somewhat behind the middle of the shell it is finely and fairly uniformly serrated (see fig. 6). The selvage is finely cross-striated along the greater part of its length. Along the free margin of the shell, about half way between the selvage and the margin of the shell, there are the openings of a large

Fig. CXII. — *Halocypris brevirostris* (J. D. Dana). — 1. Shell seen from the side, ♀; 44 ×. 2. Shell seen from the side, [illegible] 72 ×. 3. Left valve seen from the side, [illegible] 44 ×. 4. Shell seen from below, ♀; 36 ×. 5. Shell seen from behind, [illegible] 36 ×. 6. Margin of the left valve just in front of the unsymmetrical gland seen from inside, ♀; 834 ×. 7. Rod-shaped organ and the upper lip seen from the side, ♀; 94 ×. 8. Rod-shaped organ and the right first antenna seen from the side, [illegible] 260 ×. (Figs. 3—5 are drawn from specimens from station 8 b; figs. 1, 6, 7 from specimens from station 12 b, fig. 8 from a specimen from station 53 and fig. 2 from a specimen from station 116.)

number of solitary glands, most of which are arranged in a rather distinct row (cf. fig. 6) and a number situated irregularly; in the specimens investigated by me from 105 to 143 of these glands were found on each valve; in most cases they were quite absent inside the rostrum and along the dorsal third or half of the posterior margin of the shell. In preserved material one often sees hyaline fibres attached to these glandular exits; these are certainly solidified secretions. Outside these glands there are a small number of solitary glands, some opening inside and others outside the margin of the shell. The joined part of the lamellae is narrow. The outer lamella is not specially thin and is moderately strongly calcified; this lamella was brittle in a number of the specimens investigated by me.

First antenna: — This has five joints*. Between the first and second joint there is in most cases a rather distinct ventrally open knee. The proportion between the lengths of the joints seems fairly constant and is about as follows:

$$\mathrm{I} : \mathrm{II} : \mathrm{III} : \mathrm{IV} : \mathrm{V} = \tfrac{10}{10} : \tfrac{7}{6} : \tfrac{3}{1} : \tfrac{4}{2} : \tfrac{1}{1}.$$

The first joint has not disto-ventrally any verruciform process as in (all?) the males of the genus *Euconchoecia* (this is presumably a genus character). The dorsal bristle of the second joint is situated at about the middle of the joint; it is powerful, has short hairs and is comparatively long, being in most cases equal to the total length of the four distal joints of this antenna. The bristles of the two distal joints vary somewhat in length. The e-bristle of the end joint is about two or three times as long as this limb and is sometimes about as long as, sometimes a little longer than, sometimes considerably shorter than twice the length of the a—d-bristles; the e-bristle is only slightly or sometimes not at all widened along its distal half, and is furnished with only a few hairs. All the joints are quite bare.

Second antenna: — Protopodite: This is of moderate size; in specimens with shells about 1.4—1.5 mm. long it attained a length of about 0.6—0.7 mm. Its distal-lateral verruciform process varies somewhat in shape; it is often of the type reproduced in fig. 9. Exopodite: This is rather slightly shorter than the protopodite. The proportion between the lengths of the exopodite and the protopodite is about 6:7. The first joint is relatively long; the relation between its length and the total length of the eight distal joints is about 4:2 or even 5:2. The eighth joint is rather well developed and almost as long as the immediately preceding joints. The first joint is bare; its ventero-distal bristle is fairly straight and is about as long as or somewhat longer than the second joint, annulated, bare or sparsely furnished with exceedingly short hairs. The natatory bristles on the second to the eight joints are all of about the same length — the distal ones are only slightly shorter than the proximal ones and about one and a third or one and a half times as long as the exopodite; their distal parts, about a fifth or a sixth of the length of the bristles, are bare, hyaline, but very slightly or not at all widened in the shape of a lanceet (sensory organs); they are furnished with relatively long natatory hairs almost down to the base. The end joint has three bristles: One of these is sparsely furnished with short, fine hairs or is bare, and is about as long as the total length of the four distal joints, the second is of the same type, but is, in most cases, somewhat longer than the eight distal

* For CH. JUDAY's statement about six joints on this antenna see p. 600 below. For the explanation of the third joint see p. 577 above.

joints, the third, the ventral one, is a little longer still and of the same type as the natatory bristles on the preceding joints, but has somewhat fewer natatory hairs. E n d o p o d i t e (figs. 10 and 11): Of the a- and b-bristles on the first joint the latter is often about half as long as the breadth of this joint, the former is only half the length of the b-bristle or still shorter; both are bare or almost bare. Second joint: The c- and d-bristles are somewhat shorter and weaker than the b-bristle and have short and exceedingly fine hairs or are bare. The f-, g-, h-, i- and j-bristles are of the same types and relative lengths as have been stated by G. W. MÜLLER, 1906 a; see pl. VII, fig. 26. The g-bristle is about as long as or somewhat longer than the protopodite; it varies somewhat in width. The f- and g-bristles are furnished with sparse and very short hairs, the h-, i- and j-bristles are bare. Proximally on the end joint (proximally of the h-bristle) there is a low peg, which is sometimes rather difficult to verify with certainty. The clasping appendage of this joint is subject to only rather slight variation; it is always (even in the small specimen) of the types reproduced in the accompanying figs. 10 and 11. It has about six to ten transverse folds distally, and sometimes there is a small process distally, as in pl. VII, 21, G. W. MÜLLER, 1906 a. Pilosity: The first endopodite joint is partly furnished with short hairs.

M a n d i b l e (fig. CXIV): — P r o t o p o d i t e: Coxale: The toothed edge of the pars incisiva has, apparently constantly, eight simple, smooth, triangular teeth, the most posterior one of which is rather large and powerful; the others are of moderate size, either subequal or else decreasing somewhat in size the more posteriorly they are situated (almost constantly of about the type reproduced in fig. 19). The distal tooth-list, which is not inconsiderably narrower than the toothed edge of the pars incisiva, is furnished posteriorly with a large and powerful, smooth, tusk-like tooth and in front of this a row of about 15–19 smooth triangular, rather small, often subequal teeth. The proximal tooth-list is rather narrow, in most cases only about a third of the width of the toothed edge of the pars incisiva, and is fixed at about the middle of the distal tooth-list; it consists of about five to ten triangular, smooth teeth, varying somewhat in size and type. The masticatory pad is very small, almost completely reduced and of a somewhat irregular type, varying in shape in different individuals. Close to (behind) the masticatory pad there is one (rarely two) somewhat lancet-like or leaf-like chitinous appendage of moderate size, which was homologized by C. CLAUS, probably correctly, with a „Stachelzahn“. Proximally of these appendages there is a group of moderately long, rather narrow, stiff hairs; cf. the accompanying fig. 18. Basale: Of the six teeth on the distal edge of the endite the five anterior ones are usually subequal and of moderate size; they are triangular and have rather strong secondary teeth proximally; the posterior one is in most cases somewhat smaller than the former ones, but approaches their type. The two posterior processes on this edge are subequal and moderately strong; both have short hairs; the distal one is of the tube-bristle type, the proximal one, which is rather considerably displaced proximally, (see the accompanying fig. 22) is pointed. The solitary tooth on the outside of this endite is situated proximally of the first and second distal teeth (counting from in front); in most cases it is somewhat smaller than these, triangular and smooth. Of the four bristles on this endite three are situated, as mentioned above, on the outside of the process, the fourth on the anterior edge of the process, in most cases somewhat distally

Fig. CXIII. — *Halocypris brevirostris* (J. D. DANA). 9. Distal part of the protopodite of the left second antenna seen from outside, ♀; 450 ×. 10. Endopodite of the right second antenna seen from inside, ♂; 292 ×. 11. Endopodite (distal part) of the left second antenna seen from inside, ♂; 292 ×. 12. Endopodite of the left second antenna seen from inside, ♀; 450 ×. 13. First endite of the maxilla, ♀; 807 ×. 14. Second endite of the maxilla, ♀; 807 ×. 15. Endopodite and basale of the left maxilla seen from inside, ♀; 348 ×. (Fig. 13 is drawn from a specimen from station 8 b; figs. 10—12, 14, 15 from specimens from station 12 b; fig. 9 from a specimen from station 53.)

of half the height of the process. Of the three former ones two are placed rather near each other a short distance proximally of the two posterior more or less bristle-like appendages of this process, the third is situated near the anterior edge of the process, a short distance proximally of the bristle on the anterior edge. The two former of these bristles are most frequently subequal and about as long as the breadth of the endite distally; the two anterior ones vary somewhat in length, and are usually two or three times as long as the two posterior ones. Distally on the inside on this joint there is a single bristle, about as long as or somewhat shorter than the first endopodite joint. All these five bristles have short, fine hairs. There is no e p i p o d i a l a p p e n d a g e. The e x o p o d i t e is represented only by one bristle, situated somewhat laterally. This bristle, which is most frequently about as long as or somewhat longer than the anterior side of the first endopodite joint, is, contrary to the rule in this sub-family, sometimes furnished with short, fine hairs or quite bare. E n d o p o d i t e (fig. 17): The antero-distal bristle of the first joint is about as long as or somewhat longer than the anterior side of the following joint. On the posterior side the first joint has four bristles; of these the lateral one is rather powerful and long, almost as long as the endopodite; of the three others two are about as long as the height of this joint, the third is about twice or not quite twice as long. Second joint: The three antero-distal bristles are of somewhat different lengths, the longest being about as long as or somewhat shorter than twice the length of the third endopodite joint, the shortest about as long as this joint. The two posterior bristles of this joint are most frequently subequal and are almost as long as the longest posterior bristle on the preceding joint. End joint: Of the seven bristles four are in most cases subequal, being most frequently somewhat longer than the anterior side of the two distal joints; one, the most anterior, is of about the same strength as the four former ones, but in most cases it is about a third shorter than these; the two remaining ones, situated postero-medially on the joint, are considerably weaker than the former bristles and about as long as or only rather slightly longer than the end joint. All the bristles on the endopodite have short, fine hairs. Pilosity: Besides the groups of hairs posteriorly on the endite the basale often seems to be also hairy distally on the inside, sometimes even on the anterior side of the endite. The first and second endopodite joints are bare.

M a x i l l a: — P r o t o p o d i t e: The endite on the procoxale (fig. 13, ♂ = ♀), is furnished with only six bristles. Two of these, the antero-inner and the postero-outer ones, are of the tube-bristle type. The former of these is moderately long, rather powerful and provided distally of the middle with an oblique wreath of long, stiff secondary bristles. The other, which is attached somewhat proximally of the rest, is rather considerably shorter and weaker than the antero-inner one and has short, fine hairs or is almost bare. The four remaining bristles on this endite are rather powerful, finely pectinated or almost bare and of moderate and somewhat different lengths. (The proportions of these bristles are often the same as in the accompanying figure.) The endite on the coxale (fig. 14, ♂ = ♀) has twelve bristles, seven of which are situated on the posterior and five on the anterior process. Of the seven former ones the postero-inner one, which is situated a short distance proximally of the others, is rather powerful, moderately long, pointed and moderately strongly pectinated. The most anterior one is in most cases of about the same length, strength and type as the former one, but its pectination varies. Of the

remaining bristles on this endite two are of the tube-bristle type and three are pointed. The tube-bristles are rather weak, with short, fine hairs or bare and are of moderate and somewhat different lengths, the shortest often being not quite half as long as the postero-inner bristle of this endite. Of the three pointed ones, all of which are bare or armed only with a rather slight number of weak secondary teeth, two are often subequal and about as strong as the postero-inner bristle, but in most cases about a third shorter than this; the third is most frequently short and rather weak. (The proportions of these bristles are in most cases the same as in the accompanying figure.) Of the five bristles on the anterior process of this endite the antero-outer one is of about the same type as the postero-inner bristle on the posterior process of this endite, but is considerably weaker and somewhat shorter than this; its length varies, however, to some extent. The bristle situated next to this is of the same type and of about the same length and strength as the longest tube-bristle on the posterior process. The three remaining ones are pointed and bare or armed only with a small number of rather weak secondary teeth; one of them is of about the same strength and length as the shortest pointed bristle on the posterior process, one is in most cases about as long as or somewhat shorter than the postero-inner bristle of the posterior process, but is somewhat more powerful than this; the remaining one is also rather powerful, but is somewhat, sometimes considerably, shorter than the latter bristle (on the anterior process). The basale has a single short-haired or almost bare tube-bristle, the point of which reaches or goes a short distance past the distal boundary of the first endopodite joint. Endopodite (fig. 15, ♂ = ♀): First joint: This has along the anterior edge four to six rather long bristles, often differing somewhat in length; the longest is about as long as or somewhat shorter than the length of this joint, the shortest is about as long as the distal breadth of this joint; sometimes they are subequal; their position varies somewhat; they are all furnished with short, fine hairs; the distal one is sometimes of the tube-bristle type, the others are pointed. On the posterior edge of this joint there are three bristles, situated rather near each other somewhat distally of the middle of this joint; they are of somewhat different lengths, varying within about the same extremes as the bristles on the anterior edge of this joint; they have short, fine hairs and are of the tube-bristle type or pointed. The inner bristle on this joint is in most cases situated somewhat distally of the middle of this joint; it is often about half as long as this joint, has short, fine hairs and is usually of the tube-bristle type. The end joint is rather short and thick, only about half as long as the breadth of the first endopodite joint at the middle. It has five distal bristles. Of these the anterior and the posterior ones are rather strong, the others are moderately strong or rather weak. The anterior one is often about as long as the anterior side of this joint, the posterior one is in most cases not quite twice as long. The three others are of somewhat different lengths, the longest being in most cases about as long as or somewhat shorter than the posterior one, the shortest often only half this length. All these five bristles have short, fine hairs or are almost bare; some of them are (at least sometimes) of the tube-bristle type. Pilosity: Most frequently completely bare; the second endopodite joint is, however, sometimes furnished with short, fine hairs. It is to be noted that the first endopodite joint is quite without spines distally on the inside.

F i f t h l i m b (fig. 23, ♂ [illegible]): — The p r o t o p o d i t e is unjointed. On its first endite there is one short tube-bristle with short hairs. On the second endite there are three bristles, one of which is about as long as or somewhat shorter than the breadth of the protopodite (calculating from front to back); it has short hairs and is usually pointed; the two others are most frequently tube-bristles with short hairs; they are rather short, the smaller one being about as long as the bristle on the first endite. The e p i p o d i a l p l a t e has five bristles in the middle group. E n d o p o d i t e: This has almost constantly eight bristles; only on one fifth limb of one specimen were nine found. Two of these, situated on the antero-ventral corner of the process, are rather powerful and bare or almost bare; the others are moderately strong or rather weak, with short hairs or almost bare. They are all of moderate and somewhat different lengths, the longest being about as long as the longest bristle on the second endite of the protopodite, the shortest about half this length; a number of them are of the tube-bristle type. E x o p o d i t e: First joint: This has five short-haired ventral bristles, subequal or differing rather slightly in length, the longest being usually as long as the height of this joint proximally; some of them are of the tube-bristle type; one of these five bristles is situated near the distal boundary of this joint, the rest are scattered somewhat more proximally. The bristle situated dorso-distally on this joint is very long, being about the total length of the first and second exopodite joints; it has short, fine hairs and is pointed. Laterally, in most cases somewhat dorso-distally of the middle of this joint there is a short-haired, pointed bristle, which is about as long as the second exopodite joint. The three bristles of the second joint are often subequal and about as long as this joint; they have short hairs; the two ventral ones are usually of the tube-bristle type, the dorsal one sometimes of this type, sometimes pointed. End joint: Its three bristles are about as long as the second exopodite joint; the dorsal one is usually only slightly longer than the middle one, the latter is most frequently slightly longer than the ventral one; the lengths of these three bristles are, however, subject to some variation. The middle one of them, which is in most cases somewhat more powerful than the others, has a point of about the same type as is reproduced below in fig. 28 of *Conchoecia symmetrica*; the two others are of the tube-bristle type; they are all furnished with fine, short hairs or are almost bare. This limb is practically always quite bare.

S i x t h l i m b (fig. 24, ♂ almost [illegible]): — This is of moderate size and strength and has moderately strong musculature; presumably it is not used as an auxiliary organ in swimming. The p r o t o p o d i t e is in most cases rather distinctly two-jointed. The e n d o p o d i t e is only partly joined to the protopodite; a remnant of its musculature can be observed. It has two bristles, one of which is in most cases about as long as the first exopodite joint, the other somewhat longer; the shorter one has short hairs or is almost bare, the longer one is most frequently plumous at the middle; both are pointed. E x o p o d i t e: First joint: Ventrally this has three bristles, subequal, or differing only rather slightly in length and about as long as the longer of the two bristles on the endopodite; one of these three bristles is situated about half-way along the joint, the two others more or less distally; they are all of the same type, pointed, and in most cases plumous at the middle. The dorso-distal bristle on this joint is of the same type and of about the same length as the three ventral ones; it is often of the tube-

Fig. CXIV. — *Halocypris brevirostris* (J. D. DANA). — Mandible. 16. Left mandible seen from inside, [illegible]; 225 ×. 17. Endopodite of the left mandible seen from inside, ♂; 225 ×. 18. Pars incisiva of the right coxale seen from inside; ♂; 636 ×. 19. Left toothed edge of the coxale seen from inside, ♀; 1050 ×. 20. Left distal tooth-list seen from inside, ♀; 1050 ×. 21. Left proximal tooth-list seen from inside, ♀; 1050 ×. 22. Distal edge of the endite of the left basale seen from inside, the anterior bristle is broken, ♂; 636 ×. (Figs. 16, 18, 20 and 21 are drawn from specimens from station 8 b, the others from specimens from station 12 b.)

bristle type. Second joint: Ventrally at or somewhat distally of the middle of the joint there is a single short-haired bristle, either pointed or of the tube-bristle type, about as long as this joint or somewhat longer. Third joint: The two bristles are subequal, often about as long as the bristle on the preceding joint, and have short hairs; they are pointed or of the tube-bristle type. Fourth joint: Of the three bristles on this joint the two dorsal ones are often subequal and about as long as the total length of the second and third exopodite joints, the ventral one is somewhat shorter, but their lengths vary to some extent; they correspond in type to the three bristles on the end joint of the preceding limb. Pilosity: The first exopodite joint is partly furnished with short, fine hairs. Apart from these this limb is usually bare.

Seventh limb: — The longest bristle is about a third of the length of the shell (for instance in a specimen with a shell about 1,5 mm. long it measured 0,45 mm.). The end joint always seems to be smooth.

The penis is of the type described by C. CLAUS; see this writer, 1891 a, pl. XXII, fig. 11. There is no copulatory appendage; see the accompanying fig. 25.

The furca (fig. 26, ♂ = ♀) has seven claws. The armature of the claws is moderately strong. There is no verruciform process between the first and second claw. Behind the claws there is (always?) an unpaired short-haired bristle of varying length, sometimes about as long as the second or third claw, sometimes only about as long as the seventh claw. The lamellae are often furnished with groups of short, stiff hairs on the inside.

The rod-shaped organ (figs. 7 and 8, ♂ = ♀) is of about the same type as is described by G. W. MÜLLER, 1906 a; it is loosely joined to the first antenna by the dorsal bristle on the second joint of this limb.

Upper lip: — This projects rather slightly; it is rounded anteriorly and has no verruciform swellings (see fig. 7, ♂ = ♀). The exits of the glands of the upper lip are scattered on the antero-ventral side of the lip, but are, however, arranged to some extent in two longitudinal bands, each running on one side of and at some distance from the middle line. The posterior ventral margin of the upper lip is cut off transversally (see fig. 27, ♂ = ♀). Its combs project rather slightly and are furnished with rather numerous and moderately fine hairs. In the inner corner of each of these combs there issue, as in the genus *Conchoecia*, one or two glands. The part between these combs is in most cases rather narrow, sometimes only slightly more than half the width of the combs, sometimes, however, as broad as them; it is rather deeply concave in the middle; this concavity is sometimes rather broad and rounded as in the accompanying figure, sometimes rather narrow.

The paragnates are oval; the hairs on the margin are also fine. The chitinous lists behind the under lip are of the type reproduced by C. CLAUS, 1874 b, pl. III, fig. 26, i. e. they differ from the types developed in both the genera *Euconchoecia* and *Conchoecia* because the ⊥-shaped posterior part in the latter genera has in *Halocypris* a backward pointing process at the middle, by which it becomes +-shaped.

Female: —

Shell: — Length: According to G. W. MÜLLER, 1906 a, „bis 1,85 mm.“; according to the same author, 1912, the maximum length for this species is 1,8 mm. The mature females

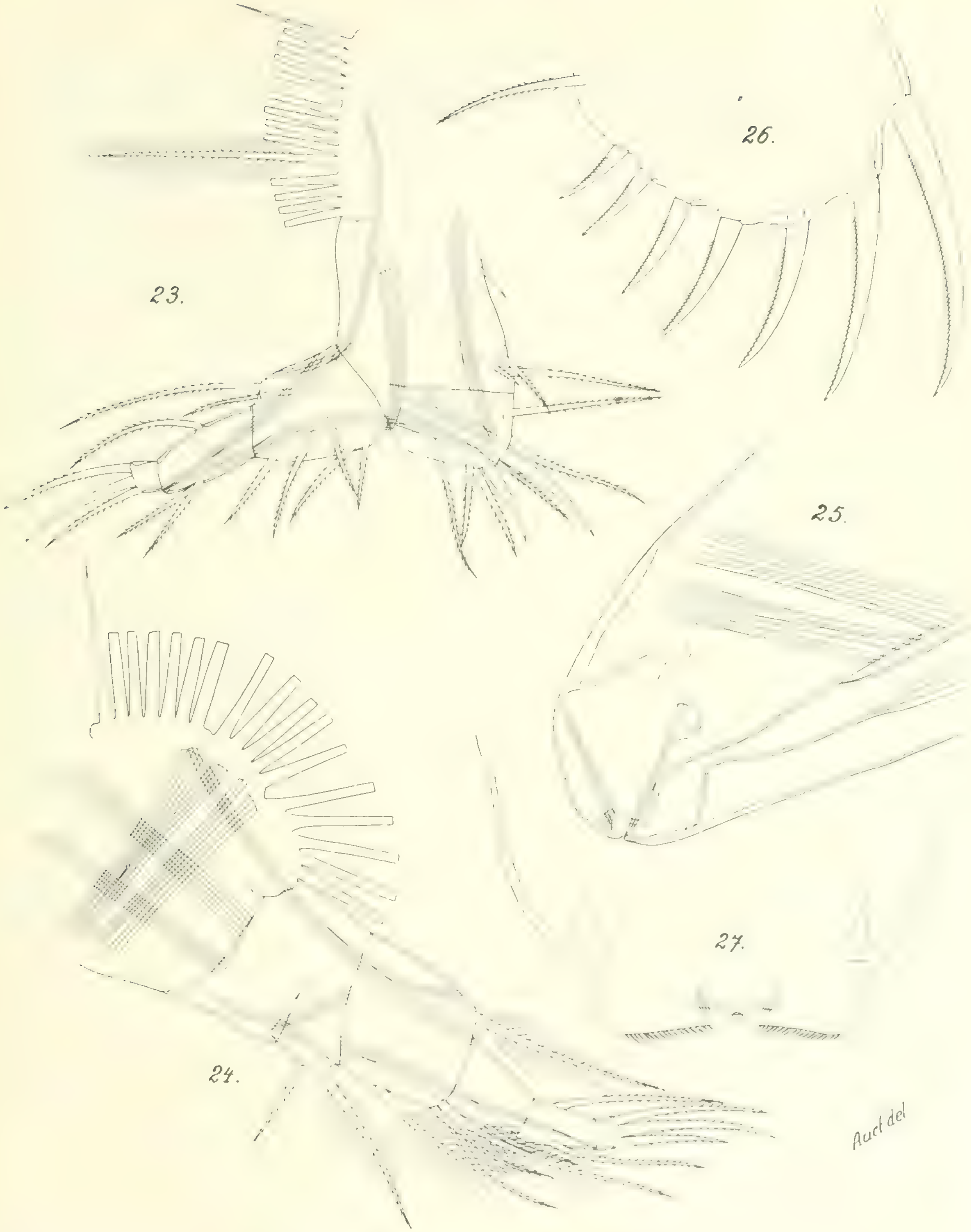

Fig. CXV. — *Halocypris brevirostris* (J. D. Dana). — 23. Left fifth limb seen from inside, ♀; 180 ×. 24. Left sixth limb seen from outside, ♀; 180 ×. 25. Distal part of the penis seen from outside; 450 ×. 26. Furca, ♀; 292 ×. 27. Upper lip, [illegible]; 292 ×. (Figs. 23, 24 and 26 are drawn from specimens from station 8 b, all others from specimen from station 12 b.)

of this species investigated by me, 28 individuals from five localities, had shells from 1,6 to 1,8 mm. long. The proportion between the length and the height varies somewhat; it is about 1,1—1,25 : 1; length : breadth about 1,25 : 1. Seen from the side the specimens investigated by me were of about the type reproduced in pl. VII, fig. 19. G. W. MÜLLER, 1906 a, or else they were not quite so ventricose at the back; see the accompanying fig. 3. Seen from beneath the shell is of the same type as that of the male, but, as is seen from the figures given above, not inconsiderably wider; its greatest breadth is at about the middle (fig. 4). Seen from behind (fig. 5) it is also of about the same type as that of the male, apart, of course, from the fact that it is wider. In other respects it resembles that of the male.

Second antenna: — The protopodite (fig. 9) is rather slightly smaller than in the male; in females with shells 1,6—1,7 mm. long this part was about 0,6 mm. in length. (By way of comparison it may be mentioned that in females of *Conchoecia elegans* of about 1,6 mm. in length the protopodite attained a length of about 0,7 mm.) Endopodite: This has three joints: the small end joint is always distinctly marked off proximally; see the accompanying fig. 12. The a-, b-, f-, g-, h-, i- and j-bristles are quite or almost quite similar to those of the male. A peg-like process of the end joint is fixed between the h- and i-bristles. On the other hand this joint is without the proximal peg-like process that is found on this joint in the male.

Mandible (fig. 16): — This differs from that of the male in the following respects: Endopodite: The first joint has only two bristles ventrally, which, to judge from their position, are homologous with the lateral and the distal of the medial ones in the male; in most cases they are somewhat shorter, relatively, in the female than in the male. Second joint: Of the two postero-distal bristles one is about as long as in the male, the other is about a third shorter. End joint: The third bristle, counting from in front, is decidedly more powerful than the others and is usually about as long as the endopodite. The two bristles in front of and the nearest bristle behind this bristle are in most cases subequal and about a third shorter than the latter. Of the three others, the posterior ones, the two medial ones are about as long and as strong as in the male, the third is most frequently somewhat longer than the two anterior bristles on this joint, but not quite so long as the long bristle situated in the middle. The pilosity is considerably less developed than in the male; the second protopodite joint is almost quite smooth; there never seem to be any hairs distally on the inside of this joint. In other respects this limb agrees with that of the male.

Sixth limb: — This is of the same type as in the male, but some bristles, especially the dorso-distal and ventero-distal ones on the first exopodite joint, are somewhat longer (see the accompanying fig. 24).

The rod-shaped organ is of the same type as in the male.

Synonymy and name.

Remarks: — As is shown above, I have accepted — on the whole without alteration — the list of synonyms worked out by G. W. MÜLLER for the species described above. My reason for doing this was that, like this writer, I was convinced that all the forms of this genus whose shells are characterized by rostra of the type reproduced above, belong to one and the same species.

I have decided, though only after much hesitation, to follow the example of this writer (1906 a) in identifying J. D. DANA's two species *Halocypris brevirostris* and *H. inflata*, first with each other, and secondly with the form described above. This writer does not give any arguments in favour of this procedure of his, and yet it seems to need to be particularly well supported by reasons; it is certain, however, that he does not base these identifications on a re-examination of J. D. DANA's original material. — J. D. DANA's descriptions and figures of the forms in question are unfortunately too incomplete and uncertain to permit of a quite certain identification of the species. The only thing there really is for one's guidance is the shape of the shells; the limbs are too incompletely discussed in the original descriptions of these forms and are too uniform in this genus to be used as material for proof in this question. With regard to the shape of the shells there is, however, a by no means complete agreement between the figures given by J. D. DANA and those given by me above (or with those worked out by G. W. MÜLLER, 1906 a); on the contrary, apart from the figures of the shells as seen from below, there are not inconsiderable differences to be observed. The greatest resemblance is to be found between J. D. DANA's figure of the shell of *H. brevirostris* as seen from the side (1852, pl. XCI, fig. 9 b) and the figure given by me above of the small male from Station 116 of the Swedish Antarctic Expedition. The resemblance between these figures is, as a matter of fact, so great that it forms a very strong argument in favour of identity. There is less resemblance between J. D. DANA's profile figure of *H. inflata* (1852, pl. XCI, fig. 8 b) and the specimens investigated by me. This figure resembles most closely — by its great height — the type of shell in the females investigated by me. It is possible that J. D. DANA's species *H. brevirostris* corresponds to the male and *H. inflata* to the female of the forms re-described by me above. This assumption is supported by the length of the shells as well as their shape; J. D. DANA gives a length of 1,6 mm. (one sixteenth of an inch) for *H. brevirostris* and 1,7 mm. (one fifteenth of an inch) for *H. inflata*. It is impossible, however, to be quite certain in this matter before the specimens investigated by J. D. DANA have been re-examined.

On the other hand I was unable to accept G. W. MÜLLER's choice of the name for this form (*H. inflata*). In J. D. DANA's main work, 1852, *H. inflata* is certainly placed before *H. brevirostris*, but in „Conspectus Crustaceorum“, 1849, the preliminary treatise of this work, *H. brevirostris* is, on the contrary, placed before *H. inflata*. According to Art. 26 c of the international rules for nomenclature* *H. brevirostris* should thus be used as the name of this species.

There are no figures of *H. brevirostris*, J. LUBBOCK, 1860; the statement: „the anterior notch is single in one valve and double in the other“ is, however, a strong argument in favour of the identification made above. It is fairly certain that the same author's species *H. Toynbeeana* is identical with the male of the species dealt with me above; the agreement in the shape of the shell is striking.

C. CLAUS, in his little essay on „Die Gattungen und Arten der Halocypriden**, 1874 a, describes (p. 177) a new species of this genus, *H. concha*. (This is described in more detail in

* Zoolog. Anzeiger, Bd. XXVIII, p. 579.

** C. CLAUS writes as follows in this work, p. 178, with regard to the two forms of J. D. DANA's just mentioned. „Hierher gehören auch DANA's *H. inflata* und *brevirostris*, die jedoch als Arten nicht zu trennen sind und ausschließlich nach Weibchen beschrieben wurden“. CLAUS was consequently the first to identify these two forms with each other. In later works of C. CLAUS's these species are not mentioned.

this writer's work of 1874 b.) In a later work, 1890, this investigator includes, besides this species, two more species of this genus, *H. pelagica* and *H. distincta*. Of these species C. CLAUS includes only *H. concha* and *H. pelagica* in his large monograph on this family, 1891 a. *H. distincta*, the most important character of which was that its shell was furnished „mit zahlreichen runden, im Centrum von je einem Porus durchbrochenen Gruben" (presumably, as G. W. MÜLLER pointed out, 1906 a, p. 50, not cavities, but calcareous concretions of an artificial nature), is not mentioned at all; C. CLAUS presumably discovered that it did not deserve the term ‚distincta'.

Different opinions have prevailed with regard to *H. concha* and *H. pelagica*. Many investigators have taken them to be well differentiated species, e. g. G. S. BRADY and A. M. NORMAN, 1896, G. S. BRADY, 1897 and V. VÁVRA, 1906. G. W. MÜLLER, on the other hand, grouped them together as one species in his work, 1906 a, and retained this view in his following works. The only author who has clearly followed G. W. MÜLLER in this question is TH. SCOTT, 1912 a; the other authors, A. SCOTT, 1905, P. T. CLEVE, 1905 and CH. JUDAY, 1906, have not expressed any opinion in this matter; they apparently share, however, C. CLAUS's view.

Which of these views is correct? As will be seen from the preceding I have followed that of G. W. MÜLLER. The reasons for this are as follows. According to C. CLAUS, one of the most important differences between *H. concha* and *H. pelagica* is in the size of the shell. For the former form this author gives a length of „circa 1,8 mm." (1891 a, p. 77), for the latter 1,1—1,4 mm. (loc. cit. p. 78). The comparatively great constancy — pointed out above — in the lengths of the shells in the great majority of the specimens of the form dealt with by me above (♂ = 1.4—1.6 mm., ♀ = 1.6—1,8 mm.) made me first inclined to think that this was really a case of two separate forms, a larger and a smaller one. This view of mine was quite disturbed, however, by my investigation of the small male caught at Station 116 of the Swedish Antarctic Expedition. Although this specimen had a shell of only 0.95 mm. long, it showed, curiously enough, on a particularly thorough and careful examination of all the organs, a very far-reaching agreement in all respects with the other males investigated by me. It seemed to be quite impossible to differentiate it as another species or variety. We are thus probably concerned with a species with a very great amplitude of variation as to length of shell. G. W. MÜLLER, 1906 a, has brought forward a fact that supports this view: this investigator points out in this work, p. 50, that at the same station he found numerous (28) males, which showed, with regard to the lengths of their shells, all intermediate stages between 1,2 and 1,75 mm.

The other differences adduced by C. CLAUS must also be said to be of very little value. They are partly characters which show a more or less continual variation. To this is added the not inconsiderable uncertainty of C. CLAUS's descriptions. This is probably illustrated best by the lack of agreement between the text and figures in this author's work — a contrast that was already pointed out previously by G. W. MÜLLER, 1906 a, p. 50. As an example of this G. W. MÜLLER points to the three end bristles on the sixth limb of *H. pelagica* in the work mentioned. Other examples of this might also be given; I need only mention here the proportion between the f- and g-bristles (β- and α-bristles according to C. CLAUS's terminology) on the endopodite of the second antenna in *H. concha* and the number of the furcal claws in the males

of *H. pelagica*. (With regard to C. CLAUS's description of the bristles on the endopodite of the second antenna G. W. MÜLLER writes, 1906 a, p. 51: „Bei der Länge der Borsten des Nebenastes der 2. Antn. werden sekundäre Geschlechtsmerkmale und Artunterschiede mit Charakteren, die von einer ganz anderen Art genommen sind, durcheinander geworfen." It seems to me very doubtful whether this statement is correct.) Among the characters adduced by C. CLAUS the following are variable: First antenna: The proportion between the lengths of the e-bristle and the a-—d-bristles. Second antenna: The proportion between the length of the first exopodite joint and the total length of the eight distal joints of this branch. The shape of the clasping organ on the endopodite of the males (cf. G. W. MÜLLER, 1906 a, p. 50) and the breadth of the g-bristle on this branch. With regard to the last character it is, however, to be noted that I have never found so narrow a g-bristle as in pl. XXII, fig. 5, C. CLAUS, 1891 a. The length of the end claws of the fifth and sixth limbs. The type of the frontal organ varied only rather slightly in the specimens investigated by me; there was not, however, full constancy. Variation in this organ was also observed by G. W. MÜLLER, 1906 a, p. 51.

The only one of the differences brought forward by C. CLAUS that really remains after this thinning is the number of the furcal claws. C. CLAUS gives eight furcal claws for *H. concha*, five for the males of *H. pelagica* and six for the females of the same species. The uncertainty as to the statement for the males of *H. pelagica* has been pointed out above; in pl. XXI, figs. 7 and 11 the furcae of both the male and the female have six claws (or five claws posteriorly of the „Hakenborste"). Curiously enough, I found seven claws constantly on the specimens investigated by me, i. e. a number between those given for *H. concha* and *H. pelagica*. G. W. MÜLLER writes, 1906 a, p. 51, as follows with regard to this character: . . . „doch kann ein Schwanken in der Zahl bei einer Art, die so stark in der Größe variiert, kaum überraschen. Auch dieser Unterschied scheint mir zur Spaltung der Art ungeeignet." Nor do I think it possible to ascribe any decisive significance to this difference.

It seems to me beyond all doubt that *H. brevirostris*, G. S. BRADY, 1880 and *H. concha*, G. S. BRADY and A. M. NORMAN, 1896 are identical with the form described above, in spite of a number of differences that are to be noted; see, for instance, the rostrum in pl. XXXIX, fig. 1, G. S. BRADY 1880 and the sixth limb in fig. 10 of the same plate. These differences are presumably due to lack of precision on the part of this author*.

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* It is perhaps worthy of special mention that G. S. BRADY succeeded in finding both *H. concha* and *H. pelagica* on a revision of the Ostracod material of the „Challenger" expedition. In the above-mentioned work by G. S. BRADY and A. M. NORMAN it is pointed out in a note to *H. concha*, p. 703, that „a few specimens occurred in tow net gatherings taken by the „Challenger" expedition, but were not recognized nor described by Dr. BRADY in his monograph of the *Ostracoda*". This shows as far as I can see quite clearly that these investigators did not consider that *H. concha* is a synonym of *H. brevirostris*, G. S. BRADY, 1880. But there can scarcely be any doubt that these forms are identical. As a curiosity and an example of the uncertainty of the information given by G. S. BRADY the following may be pointed out here: In the above-mentioned work by G. S. BRADY and A. M. NORMAN there is a statement to the effect that *H. concha* was caught by the „Challenger" expedition at three different stations; no locality where *H. pelagica* was found by this expedition is mentioned in this work. In G. S. BRADY's work, 1897, *H. concha* is stated to have been caught at only one station by the „Challenger" expedition, while *H. pelagica* is said to have been found at two of this expedition's stations. It is to be noted that the station for *H. concha* in the latter work is not identical with any of the three stations for this species given in the work of 1896; on the other hand one of the stations for *H. pelagica* mentioned in the work of 1897 is identical with one of the stations for *H. concha* in the work of 1896. G. S. BRADY does not give any explanation of this curious state of affairs in the work of 189[illegible].

In the case of *H. dubia* G. W. MÜLLER and its var. *major* the synonymization is based on G. W. MÜLLER's own statements.

I was somewhat doubtful whether to identify *H. pelagica*, CH. JUDAY, 1906, with the species discussed by me above, because this form comes from the west coast of America. The figures given by this writer decidedly support this procedure, however; fig. 5 in plate VII, according to which the first antenna has six joints — the first joint is divided into two joints of equal length in this figure — is certainly incorrectly drawn.

The figures of *H. inflata* and *H. globosa* given by TH. SCOTT, 1912 a, are exceedingly deficient and uncertain, but they indicate with a fair amount of certainty that the former species is identical with the male, and the latter species with the female, of the form dealt with by me above. It is to be noted that this writer calls the male reproduced on pl. XIII, figs. 29—31, a female!

The following synonyms among those included above have no verificatory descriptions and figures, but, in spite of this, they seemed to me certain for one reason or other: *H. concha* + *H. pelagica*, G. S. BRADY, 1897, *H. concha*, A. SCOTT, 1905, *H. pelagica*, P. T. CLEVE, 1905, *H. inflata*, G. W. MÜLLER, 1906 b, 1908, *H. concha* + *H. pelagica*, V. VÁVRA, 1906.

On the other hand it did not seem right to include *H. brevirostris*, TH. SCOTT, 1894, p. 141, a form that is also without any identifying figures or description. The uncertainty in this investigator's work of 1912 a, which is pointed out above, seems to be sufficient reason for this.

The larvae of this species found by me in the material of the „Antarctic" Expedition all clearly belonged to the last larval stage. Both males and females were found. In both sexes the shells were of about the same type as that which is characteristic of the mature female and showed very slight variation with regard to length; 1,0—1,1 mm. was observed. The number of furcal claws on these specimens varied from six to seven. Several of the females among these larvae had eggs in the ovary in a rather advanced state of development, so that these larvae were rather difficult to distinguish from the mature females, whose eggs are often no farther developed; the same observation was previously made by G. W. MÜLLER, 1906 a, with regard to the material of the „Valdivia" expedition. This fact, like the length of the larvae, seem to make it probable that the species *H. pelagica* of several of the preceding authors represent larval specimens of the species dealt with above.

Habitat: — Atlantic Ocean:

S. A. E., Pl. station 30, lat. 29° 52′ N., long. 20° 14′ W.; at the surface; 7. XI. 1901; temperature, 21,1° C.: 1 mature male; R. M. S. 199. S. A. E., Pl. station 4 b, lat. 25° 51′ N., long. 21° 29′ W.; at the surface; 9. XI. 1901; temperature, 22,5° C.: 3 mature males and 7 larvae; R. M. S. 189. S. A. E., Pl. station 38, lat. 25° 46′ N., long. 21° 31′ W.; at the surface; 9. XI. 1901; temperature, 22,5° C.: 1 mature male; R. M. S. 200. S. A. E., Pl. station 6 b, lat. 23° 35′ N., long. 22° 19′ W.; at the surface; 10. XI. 1901; temperature, 23° C.: 1 mature male; R. M. S. 190. S. A. E., Pl. station 7 b, lat. 22° 26′ N., long. 22° 45′ W.; at the surface; 11. XI. 1901; temperature, 23,6° C.: 1 mature male; R. M. S. 191. S. A. E., Pl. station 45, lat. 22° 8′ N., long. 22° 52′ W.; at the surface; 11. XI. 1901; temperature, 23.3° C.: 1 mature

male; R. M. S. 201. S. A. E., Pl. station 8 b, lat. 21° 51′ N., long. 23° 0′ W.; at the surface; 11. XI. 1901; temperature, 23,20° C.: 2 mature males, 4 mature females and 2 larvae; R. M. S. 192 and 193. S. A. E., Pl. station 46, lat. 21° 51′ N., long. 23° 0′ W.; at the surface; 11. XI. 1901; temperature 23,2° C.: 1 mature female and 1 juvenis; R. M. S. 202. S. A. E., Pl. station 53, lat. 18° 10′ N., long. 24° 28′ W.; at the surface; 13. XI. 1901; temperature, 23,8° C.: 1 mature female and 1 juvenis; R. M. S. 203. S. A. E., Pl. station 12 b, lat. 14° 28′ N., long. 26° 1′ W.; at the surface; 15. XI. 1901; temperature, 25,50° C.: 14 mature males, 16 mature females and 2 juvenes; R. M. S. 194. S. A. E., Pl. station 14 b, lat. 12° 21′ N., long. 26° 49′ W.; at the surface; 16. XI. 1901; temperature, 26,0° C.: 3 mature males, 6 mature females and 2 juvenes; R. M. S. 195 and 196. S. A. E., Pl. station 18 b, lat. 1° 31′ N., long. 29° 7′ W.; at the surface; 22. XI. 1901; temperature, 26,8° C.: 2 mature males; R. M. S. 197. S. A. E., Pl. station 116, lat. 15° 46′ S., long. 34° 8′ W.; at the surface; 1. XII. 1901; temperature, 26,2° C.: 1 mature male; R. M. S., on slides. S. A. E., Pl. station 23 b, lat. 19° 19′ S., long. 36° 9′ W.; at the surface; 3. XII. 1901; temperature, 25,2° C.: 3 juvenes; R. M. S. 198.

Distribution: — Atlantic Ocean from lat. 60° N. (V. VÁVRA, 1906) to lat. 40° S. (G. W. MÜLLER, 1906 a). Pacific Ocean from lat. 33° N. (CH. JUDAY, 1906) to lat. 47° S. (G. S. BRADY, 1880). Indian Ocean.

The stations of the Swedish „Antarctic" expedition at which this species was found are all within these limits.

Genus Conchoecia J. D. DANA.

For synonymy see G. W. MÜLLER, 1912, p. 59.

Description: — Shell: — This varies in shape. The rostrum is always well developed and is in most cases somewhat more bent ventrally in the females than in the males. The surface of the shell is furnished with only quite a few bristles or has none at all. The pores of the surface always seem to be moderately large and in most cases not difficult to establish. The selvage was almost always developed in the following way in the species of this genus that were investigated by me: On the rostrum it is rather broad, growing rapidly narrow dorsally and ventrally; it is narrow along the incisur; ventrally of the incisur it increases evenly in breadth and is rather broad along the anterior margin of the shell and the anterior part of the ventral margin of the shell; posteriorly it decreases again rather evenly in breadth and is always very narrow inside the ventral part of the posterior margin of the shell; at about half the height of the shell or somewhat dorsally or ventrally of this, inside the posterior margin of the shell, the selvage practically ceases altogether, although it can, at least sometimes, be traced still more dorsally in the shape of an exceedingly fine line. (If nothing special is said about it in the following descriptions of species, it is to be taken as meaning that the selvage agrees with

the type described above.) The part of the selvage that runs inside the rostrum has usually no spine-like processes. The selvage is finely cross-striated along a greater or less part of its length, but this cross-striation is often only perceptible with difficulty. The following compound glands are found in this genus: Two unsymmetrical glands as usual. Of these the left one usually has its exit just in front of the postero-dorsal corner of the shell, the right one at the postero-ventral corner of the shell or, when this is absent, at about the transition between the ventral and posterior margins of the shell (= „an gewöhnlicher Stelle", according to G. W. MÜLLER's terminology). Sometimes one or both of these glands are more or less displaced; they never emerge, however, quite symmetrically. Lateral corner glands are sometimes developed, sometimes they are quite absent; in the former case it happens exceptionally that only that on one valve is developed. The dorso-medial glands are almost always developed in the males and in exceptional cases in the females too. (Only the exceptions are mentioned in the following description of species.) Inside the rostral incisur, according to G. W. MÜLLER, 1894, the joined part of the two lamellae of the shell is more or less deep (see loc. cit. pl. 36, fig. 6, pl. 37, figs. 10 and 11); the boundary of this joined part is exceedingly difficult to establish with certainty; the part seems to me to be often rather narrow; cf. the description of *C. obtusata* below. The outer lamella is not specially thin.

First antenna: — This always shows decided dimorphism.

Male: — This is moderately long and rather powerful, growing gradually narrower distally. The two proximal joints, when in a position of rest, always point more or less straight forward, the two distal joints point in most cases rather decidedly ventrally. It has five joints, but the boundary between the second and third joints is rather often more or less difficult to establish with certainty (sometimes, e. g. *C. curta*, quite impossible). (It is to be noted that I am here counting as a special joint the little collar-like part proximally of the next to the distal joint; G. W. MÜLLER, who counts this part as a part of the second joint, consequently gives four as the number of joints in this limb; cf. p. 576 above.) The proportions between the joints seem to be subject only to rather slight variation in this genus. The two proximal joints are comparatively long and powerful, in most cases subequal, the three distal joints are always very short and rather weak; they are of about the same type as is shown in the accompanying fig. 7 of *C. symmetrica*. (If nothing special is said in the following descriptions, the species in question has about the same proportions between the joints as in the figure just mentioned.) The first joint has in most cases* no verruciform process ventero-distally as in the case of this joint in (all?) the males of the genus *Euconchoecia*. The second joint has dorsally, at or just behind a point half way along it, a rather short and powerful bristle (retinaculum), with short, fine hairs or in most cases quite bare, which fastens like a claw („ringförmig") round the rod-shaped organ and fixes it to this limb. (This joining is often so firm that the rod-shaped organ cannot be detached without this bristle being broken off from the antenna.) The next distal joint has two**, the end joint three bristles varying in length; apart from these this limb

* See *C. dorsotuberculata*, G. W. MÜLLER, 1906 a, pl. X, fig. 9.

** In pl. I, fig. 7 (*Conchoecia serrulata*) C. CLAUS, 1874 b this joint has, it is true, three bristles, but this is certainly due to a mistake.

has no bristles at all. One of the bristles on the next distal joint and two of those on the end joint, among them the one situated most distally, are comparatively long and stiff, of a more or less ordinary type, annulated proximally, more or less hyaline distally, all presumably playing a certain part in seizing and holding the female fast. The most distal of these bristles is, in most species of this genus, armed on the posterior side at about or somewhat distally of half its length with a smaller or greater number of spines, which in most cases point proximally; in a number of cases the armature of this bristle is of other types. The other two of these three bristles are usually somewhat shorter than the most distal one and are either quite bare or only slightly armed. On the proximal one of them there is rather often a more or less long pad-like appendage („Schwiele", according to G. W. MÜLLER's terminology) at about the place corresponding to the distal bristle's rows of spines. G. W. MÜLLER describes this appendage (1906 a, p. 39) as „eine zartwandige einseitige Verdickung der Borste". This author then writes: „Wie das Bild zu stande kommt, ob es sich wirklich um eine Erweiterung der Borste oder nur um einen häutigen Anhang (resp. zwei) handelt, weiß ich nicht." According to what I established with certainty in a number of species, we are not concerned with a lamelliform, but with what I may perhaps call a pad-like appendage (cf. G. H. FOWLER, 1909, p. 230) that is situated along one side of the bristle. In all the species investigated by me this pad had transverse folds (somewhat like the bellows of a camera); cf. my fig. 3 of *C. bispinosa* and fig. 7 of *C. borealis*. G. W. MÜLLER states that two such appendages are sometimes found on the same bristle, one situated opposite the other. This statement is presumably always due to a mistake; in a number of cases, e. g. in *C. antipoda*, G. W. MÜLLER, 1906 a, pl. XXVI, fig. 9, I have verified the fact that it is a mistake. An apparently double-sided pad of this sort, as shown in the figure just mentioned, originates from the fact that a comparatively high pad, placed on one side, becomes visible on both sides of the bristle under the pressure of the coverglass. One of the next distal joint's bristles and one of the end joint's proximal bristles are developed as thin-walled, bare sensorial filaments, in most cases somewhat rounded distally (as in, for instance, fig. 7 of *C. symmetrica*); they are developed in somewhat different ways in different species.

F e m a l e: — This is of about the same type as that of the male, but is rather considerably shorter and weaker. It has rather weakly developed musculature and often a rather indistinct division into joints; the number of joints is sometimes the same as in the male, sometimes it is more or less reduced by complete junction of two or more joints. The proportions between the (original) joints are about the same as in the male. (If nothing special is mentioned in the following descriptions of species, the proportions between the joints are about the same as are shown in the adjoining figure 10 of *C. symmetrica*.) The number of the bristles is either the same as in the male or else the dorsal bristle of the second joint is absent. The latter bristle is, if developed at all, pointed, of the ordinary type and does not grasp the rod-shaped organ. (The latter is consequently free from this antenna.) Of the five bristles on the two (original) distal joints the distal one on the end joint is, as is the case in the male, long and of the ordinary type, annulated proximally and more or less hyaline distally; along its posterior side at or in most cases somewhat distally of the middle it has a greater or less number of short hairs; in some cases it has, in addition, along the proximal part of the anterior side a number of more

or less long, soft hairs. The remaining four bristles on these two joints are moderately long, subequal and differentiated as thin-walled, rather narrow or moderately wide, bare sensorial filaments, more or less rounded distally. (About the same as in fig. 10 of *C. symmetrica.* If nothing special is mentioned in the following descriptions of species, these bristles are of the type reproduced for the species just mentioned.)

S e c o n d a n t e n n a: —

M a l e: — P r o t o p o d i t e: — This seems to be subject to very slight variation in this genus. In all the species investigated by me it was characterized by two processes, both situated near the exopodite, one laterally, the other medially. The lateral one of these processes is small, verruciform, and in most cases of about the same type and position as in the adjoining fig. 11 of *C. symmetrica.* The medial one is considerably larger, in most cases more or less irregularly globular. It is most frequently of the same type and position as in the adjoining fig. 13 of *C. symmetrica*; only in exceptional cases has this process another type. (Only in the latter case is this character specially mentioned in the following descriptions of species.) E x o p o d i t e: The first joint is in most cases of about equal thickness throughout its whole length, only in exceptional cases — and then this is specially mentioned in the following descriptions of species — of another type. The eighth joint is most frequently very short, sometimes even difficult to distinguish. The ventero-distal bristle of the first joint is hyaline, bare, in most cases bent vermiformly, narrow, of about the same width throughout its length, and about as long as the total length of the three following joints. The natatory bristles on the second to the eighth joints are all about the same length — the distal ones are only slightly shorter than the proximal ones. The distal part of these bristles — about a fifth to a seventh of the whole — is bare, hyaline and extended like a lancet (about the same as in pl. 5, fig. 9, G. W. MÜLLER, 1894). The proximal part of these bristles has rather long natatory hairs almost down to the base. The end joint has three bristles. The relative lengths of these are subject to rather slight variation in the species of this genus that are described below. The ventral one is usually about as long as the exopodite and of about the same type as the natatory bristles on the preceding joints, but is furnished with somewhat fewer natatory hairs and is not lancet-shaped distally, though it is hyaline and bare. The two dorsal ones are rather narrow, of about equal thickness throughout their length and in most cases hyaline and bare; only in exceptional cases do these two bristles have short hairs. One of them is about as long as the total length of the five or six distal joints, the other is about twice as long; cf. the accompanying fig. 12 of *C. symmetrica.* E n d o p o d i t e: First joint: This is moderately large and somewhat irregular in shape. It is about as long as it is broad; it is somewhat irregularly rounded posteriorly, its anterior side has two processes; one of these, the processus mammillaris, situated at about the middle of the anterior side, is moderately large or rather small, more or less conical, the other, situated somewhat distally of the former one, is somewhat larger, and is verruciformly rounded. This joint was of about the type reproduced in the adjoining figs. 13 and 14 of *C. symmetrica* in almost all the species of this genus described by me below; only in those cases where it is specially mentioned below was there any deviation from this type; it is, however, to be noted that the little verruciform appendage situated distally on the processus

mammillaris that is drawn in these figures is only seldom developed. Of the two bristles on this joint, both of which are attached distally on the antero-distal process of the joint, the distal one, the b-bristle, is in most cases of about the same length as the proximal breadth of this process, the proximal one somewhat shorter; cf. figs. 13 and 14 of *C. symmetrica*; only in exceptional cases — which are specially mentioned in the descriptions of species — are there deviations from this rule. The second joint is rather short, but rather powerful; it is most often of about the same shape as in my figs. 13 and 14 of *C. symmetrica* (only exceptions are noted in the descriptions of species). It is most frequently armed with five bristles. Of these the c- and d-bristles are rather short and weak, pointed and of the ordinary type, the f- and g-bristles, on the other hand, are comparatively long, the g-bristle is in most cases longer than the f-bristle; they are rather powerful proximally, hyaline distally and obviously function as sensory organs. Besides these four bristles there is, as has been mentioned, an additional bristle, the e-bristle; this, which is situated somewhat distally of the c- and d-bristles at the base of the f-bristle, is always more or less short, pointed and of the ordinary type. The end joint varies very much in type. The three bristles on this joint, the h-, i- and j-bristles, are subequal, always shorter than the f- and g-bristles and developed as hyaline, thin-walled (only exceptionally, as in the case of *C. Giesbrechti*, partly thick-walled) sensorial filaments, attached a short distance distally of the proximal boundary of this joint. The first endopodite joint always seems in this genus to be furnished with exceedingly close short, fine spines on a rather large part of its surface.

F e m a l e: — The p r o t o p o d i t e is like that of the male except for the fact that it has no disto-medial verruciform process. The e n d o p o d i t e has two or three joints. The first joint is about the same as that of the male. The original second joint is weaker than that of the male and more or less cylindrical. The third joint is extremely small in those cases when it is developed at all.* The bristles of the first joint are about the same as in the male. Of the bristles on the original second joint only two are developed in most cases, namely the f- and g-bristles; the c-, d- and e-bristles are almost always quite absent (only when one or more of these bristles are developed is it stated in the following descriptions of species); the f- and g-bristles are developed in about the same way as in the male. On the little end joint the h-, i- and j- bristles are always developed and in most cases they are of about the same type as in the male. Between the h- and i- bristles there is also in a number of species a short, peg-like process or a short bristle. (For the morphological value of this bristle see p. 584 above, the remark on the genus *Halocypris*.) The first endopodite joint is, as in the case of the male, furnished with short and fine spines.

M a n d i b l e: — This limb seems to be subject to rather slight variation in this genus. In most of the species investigated by me I found — apart, of course, from small individual variations — quite the same type as far as most characters were concerned. In some species, however, more or less deviating types were observed; in this case it was not always the same character that varied, but sometimes one, sometimes another. Under these circumstances it seemed to

* All the previous writers state that this branch is always two-jointed. G. W. Müller, however, has observed that three joints are sometimes developed; cf. G. W. Müller, 1906 a, p. 98. He has, however, obviously forgotten this fact in working out the genus diagnosis.

me best, in order to avoid too much repetition in the following descriptions of species, to describe here what one might call the normal type of this limb in this genus. When a character of this limb is not specially mentioned in the following descriptions of species, it thus means that in the species in question this character agrees with what is denoted here as the most usual state of affairs. — This limb shows no, or at any rate scarcely perceptible, dimorphism. — Protopodite: Coxale: The toothed edge of the pars incisiva is in most cases of about the same type as that reproduced below in fig. 16 of *C. symmetrica*, i. e. the most anterior tooth is very powerful, smooth, low, broad, rather transversally and evenly cut off distally; the others are also smooth and decrease, though somewhat irregularly, in size and strength the more posteriorly they are situated; the anterior ones are moderately large and somewhat irregularly triangular, the posterior ones are very small; the posterior part of this edge can conveniently be described in this type as being irregularly undulated. The number of these teeth is rather difficult to establish with certainty on account of the small size of the posterior teeth and it varies somewhat even within the species. The toothed edge seldom varies from this type. In some species, however, variations were observed with regard to the teeth situated behind the large anterior tooth. These are sometimes subequal — or else the most posterior one is even somewhat more powerful than its neighbours — and are all relatively smaller than the anterior ones of these teeth in the type described above, irregularly triangular and smooth (cf. my figure 9 of *C. rotundata* G. W. MÜLLER). In one species (cf. my figure 6 of *C. Gaussi*) this toothed edge ends posteriorly with a low, broad, irregularly rounded tooth; the teeth nearest to the large anterior one are of about the same type as in the „normal type" described above, but somewhat less relatively; the other teeth decrease in size and strength the more posteriorly they are situated; the part just in front of the broad rounded posterior tooth is finely serrulated. The two tooth-lists and the masticatory pad show such great variability that it did not seem to me convenient to describe them in this connection. I need only point out here that the tooth-lists often exhibit a certain variability even within the species and that the masticatory pad is always well developed. Along the posterior edge of the pad-like part of the pars incisiva there are four more or less broad lancet-bristles and also a large number of rather short or moderately long bristles, situated close together and simple or somewhat bifurcated distally. Basale: This is in most cases of about the type reproduced by me in fig. 22 of *C. symmetrica*; its relative length is in exceptional cases somewhat less and it has sometimes a relatively stronger endite. The six teeth on the distal edge of the endite are in most cases all of about the same size and type. These teeth have most frequently the following type: They are moderately large and almost equilaterally triangular; about the proximal halves of the anterior and posterior edges are exceedingly finely serrulated; in a number of cases this serrulation is rather strong. In exceptional cases (cf. my fig. 10 of *C. Gaussi*) these teeth are relatively low, the proximal serrate teeth on one or both of the edges are, on the other hand, very powerful, i. e. the difference between the main points of these teeth and the serrate teeth has almost disappeared in this type. The two posterior processes on this edge are subequal, moderately strong, bare or furnished with a few secondary spines; the distal one of them is of the tube-bristle type, the proximal one, which is situated rather slightly proximally of the former

one, is in most cases dagger-shaped; in exceptional cases it, too, is of the tube-bristle type. The single tooth on the outside of this process is situated a short distance proximally of distal teeth nos. 1—3 (counting from the front); it is more ot less broadly triangular and is in most cases somewhat larger than the distal teeth. My fig. 19 of *C. symmetrica* agrees very closely with the normal type described above. This endite always has, as is pointed out above, four bristles, one of which is situated on the anterior edge of the process, in most cases somewhat distally of half the height of the process, the three others on the outside of the process. Two of the three latter bristles are most frequently situated in this genus at or somewhat behind the middle of the process, the third is rather near the anterior edge of the process, a short distance proximally of the first-mentioned bristle situated on the anterior edge. The two posterior of the bristles situated on the outside are most frequently subequal or differ rather slightly in length; they are about as long as the width of the endite. The anterior one of the bristles situated on the outside of the process is comparatively long, about as long as or somewhat shorter than the dorsal side of this joint. The bristle on the anterior edge of this process is about as long as or somewhat longer than the width of the process. All these four bristles have short hairs. Medially near the distal boundary of this joint there is a solitary bristle, in most cases about as long as the distal height of this joint and short-haired. The epipodial appendage is sometimes developed, but sometimes it is quite absent. The exopodite is represented by a small verruciform process, in most cases of about the same type as is reproduced in the accompanying fig. 22 of *C. symmetrica*. It is furnished with a plumous bristle, which is most frequently about as long as or somewhat shorter than the anterior side of the first endopodite joint. Endopodite: The antero-distal bristle of the first joint is about as long as or somewhat shorter or longer than the anterior side of the second endopodite joint; this bristle is sometimes plumous, sometimes short-haired; this character varies, at least in a number of cases, within the species. The posterior bristles of this joint vary in number and development. Second joint: One of the three antero-distal bristles of this joint is rather powerful and about as long as or somewhat longer than the anterior sides of the second and third endopodite joints. The two others are somewhat weaker, subequal or of somewhat different lengths; they are about as long as or somewhat longer than the anterior of the end joint. One of the two posterior bristles of this joint is rather powerful and about as long as or somewhat shorter than the endopodite, the other is about half as long. End joint: Of the seven bristles on this joint the third (counting from the front) is rather powerful and is in most cases about as long as or somewhat shorter than the endopodite. The most anterior one is also rather powerful but about a third or a quarter shorter than the former. The bristle that is situated between — and somewhat medially of — these two bristles is rather weak and is only about a third to a fifth of the length of the longest one. One of the four posterior bristles on this joint is rather powerful, about as long as or somewhat shorter than the most anterior bristle; the three others are somewhat weaker and rather short, subequal or of somewhat different lengths; the longest of them is in most cases about as long as or slightly longer than half the length of the most anterior bristle on this joint. The shorter bristles on the second and third endopodite joints are often furnished with rather short, fine hairs; the longer and more powerful ones are most frequently rather powerfully pectinated.

The figure 22 of *C. symmetrica* given by me agrees fairly well with the type described here. Pilosity: This does not seem to be quite constant within the species; the second protopodite joint is often furnished with exceedingly fine, short hairs distally medially.

M a x i l l a: — This limb too is subject to rather slight variation in this genus. In most of the species investigated by me I found almost exactly the same type. In some species, however, it differed from that of the former ones in one or more respects. Just as in the case of the mandible it was not always the same characters that differed in this way, but sometimes one and sometimes another. For this reason it seemed to me most convenient — in order to avoid too much repetition in the following descriptions of species — to give in the case of this limb too a description of what I may call the „normal type" found by me. Consequently the characters in this limb that are not mentioned in the following descriptions of species are to be taken as agreeing with this normal type. — P r o t o p o d i t e: The endite on the procoxale seems in the species investigated by me almost constantly to be armed with nine bristles (cf. *C. Valdiviae* below). These bristles vary very little in size and type. In most cases the following conditions are present: The antero-inner bristle is moderately long, rather powerful, of the tube-bristle type and armed with two somewhat irregular wreaths of rather long and stiff secondary bristles, placed obliquely. The bristle situated nearest to the former one is somewhat shorter, rather powerful, well pointed and most frequently armed with one or two irregular, obliquely situated wreaths of rather long, stiff secondary bristles and has distally of these a somewhat varying number of more or less powerful secondary spines. The wreaths of secondary bristles may be absent in this bristle. The three bristles situated just outside this bristle are of the same type as the latter, but as a rule they are somewhat longer and have no wreaths of secondary bristles; only in exceptional cases may the inner one of them be furnished with one of these wreaths. Outside these three there is a bristle of about the same type, but usually somewhat shorter and weaker. The three remaining (postero-outer) bristles are about as long as the last-mentioned one, rather weak, of the tube-bristle type and either bare or furnished with some secondary bristles or more or less weak spines. My fig. 23 of *C. symmetrica* agrees fairly well with the normal type described above. Endite on the coxale: On the posterior process of this endite there are usually ten (in exceptional cases nine or eleven) bristles. It is true that there is not complete constancy as to the type and size of these bristles — not even within the species — but in most cases the following conditions were observed by me. The two inner-posterior bristles, which are situated somewhat proximally of the others, — one somewhat proximally of the other — are subequal, moderately long, rather powerful, well pointed and rather weakly pectinated in the middle. Four (in exceptional cases three or five), situated in the midst of the remaining ones, are of the tube-bristle type, of somewhat different lengths, moderately long or rather short, rather weak and quite or almost bare. The four remaining ones are comparatively powerful, of moderate and somewhat different lengths, more or less well pointed and almost bare or armed with a more or less large number of secondary spines. The anterior process on this endite always seems to be armed with five bristles. The antero-outer one of these bristles is in most cases of about the same length and strength as the two inner-posterior bristles of the posterior process, but differs sometimes by

having its armature somewhat more powerful (this armature is, however, subject to variation even within the species). The next outer one is a tube-bristle of about the same type, size and strength as the tube-bristles on the posterior process of this endite. The three remaining ones are comparatively powerful, of moderate and in most cases somewhat different lengths, rather well pointed, almost bare or armed with rather few secondary spines. My fig. 24 of *C. symmetrica* agrees rather well with the normal type described above. The basale is in most cases furnished with a single short-haired or almost bare tube-bristle of about the same length as or somewhat longer or shorter than the first endopodite joint. This bristle has in most cases no long hair distally (cf. below); in exceptional cases it may have long secondary bristles at the middle; sometimes it may be quite absent. E n d o p o d i t e: First joint: Along the anterior edge this joint usually has six (in exceptional cases only four) long bristles, the longest ones of which are in most cases somewhat longer than the anterior side of this joint, the shortest ones about half as long as the former ones. All these bristles are well pointed except one of those situated most distally, which is most frequently of the tube-bristle type; the latter bristle is in most cases furnished distally with a rather long hair; cf. my fig. 26 of *C. symmetrica*. In most cases these bristles have short hairs, only in exceptional cases they have rather long secondary bristles at the middle. At or somewhat distally of the middle of the posterior edge of this joint there are almost always three (in exceptional cases two or four) rather long bristles of somewhat different lengths, about as long as or somewhat longer or shorter than this joint. In most cases these bristles have short hairs and are of the tube-bristle type; one or two of them have most frequently a rather long hair distally. The bristle on the inside of this joint, situated somewhat distally of the middle or rather near the distal boundary of this joint, is in most cases about as long as the width of this joint or somewhat shorter; it has short hairs, has long secondary bristles only exceptionally and is of the tube-bristle type; this bristle always seems to be without a long end hair. Near the distal boundary of this joint there is a somewhat varying number of — in most cases — rather weak spines along the anterior half of the inside. The end joint varies in length and is always armed with five distal bristles. The most anterior and the most posterior of these bristles are most frequently rather strong, slightly bent, pointed, bare or more or less finely pectinated claws (the points of these bristles are of about the type reproduced by me in fig. 28 of *C. symmetrica*). The three remaining bristles on this joint are in most cases of the tube-bristle type, with short, fine hairs or almost bare and with no long end hair. Of these bristles the most anterior claw-shaped one is usually the longest, about as long as or somewhat longer than the breadth of the first endopodite joint (counting from front to back). The most posterior claw-like one is somewhat shorter than the former one, in most cases being at least somewhat more than half its length. The three remaining ones are either subequal or somewhat different in length; the longest of them is usually somewhat shorter than the most anterior claw-shaped one, the shortest one is usually about half this length. The length of these bristles varies somewhat even within the species. Pilosity: Both the endite on the procoxale and that on the coxale are furnished with a moderate number of moderately long, stiff hairs both on the anterior and the posterior side. Apart from these this limb seems in most cases to be quite bare.

F i f t h l i m b: — For the same reasons as in the case of the two preceding limbs it seemed to me most convenient to describe in this generic description the „normal type“ of this limb as found by me. The characters on this limb that are not mentioned in the following descriptions of species are thus to be considered as agreeing with this type. — P r o t o p o d i t e: This is in most cases unjointed, but has sometimes a faint indication of two joints. The first endite has two bristles, one situated somewhat distally of the other. The proximal one of these bristles is short, has short hairs and is of the tube-bristle type. The distal one is rather long, in most cases about as long as the breadth of the protopodite (calculating from front to back), of the ordinary type, furnished along its proximal half with rather long, stiff secondary bristles, and with short hairs distally. The second endite is armed with three bristles. One of these bristles is of about the same type and length as the long bristle on the preceding endite. The two others are of the tube-bristle type; one of them has short hairs and is about as long as or somewhat longer or shorter than the short tube-bristle on the preceding endite, the other is somewhat longer, often about half the length of the long ordinary bristle, either with short hairs or with rather long, stiff secondary bristles at the middle (the latter character may sometimes vary even within the species). E p i p o d i a l a p p e n d a g e: The middle one of the three groups of bristles always seems to comprise five bristles. The e n d o p o d i t e is armed with eight, in exceptional cases nine, bristles; one of these is situated ventrally* rather far back, the others anteriorly on this branch. The latter (seven or eight) bristles are usually developed as follows: Two of them are rather powerful, moderately strongly or rather weakly pectinated claws, one of them, the ventral one, is about as long as the proximal height of the first exopodite joint, the other is somewhat shorter. One bristle, in most cases attached somewhat more dorsally than the short claw, is about as long as or most frequently somewhat shorter than the latter, has short hairs and is of the tube-bristle type. One (or in the case of nine bristles two) bristle, situated close to (in most cases somewhat dorsally of) the long claw, is also furnished with short hairs and is of the tube-bristle type, about as long as or somewhat shorter or longer than the latter. In exceptional cases the tube-bristles of this branch are very short. The three remaining (ventral ones) of the anterior bristles of this branch are in most cases rather long, of somewhat different lengths, the longest of them often being about as long as or somewhat shorter or longer than the long bristle on the first endite of the protopodite, the shortest about a quarter or a half shorter. These three bristles are in most cases of the ordinary type, either all with short hairs or else one or two of them are furnished with rather long secondary bristles at the middle (this last character sometimes varies within the species). The anterior ventral bristle on this branch is in most cases of about the same type and length as the long bristle on the first endite of the protopodite, but has most frequently softer secondary bristles; in exceptional cases this bristle is more or less short. In a number of species this branch is furnished anteriorly on the outside with a number of short spines. E x o p o d i t e: First joint: The dorso-distal bristle of this joint is in most cases about as long as or somewhat longer than the two following joints; it has

* Really laterally. The natural position of the endopodite is altered under the coverglass. Whereas the anterior bristle-bearing edge of this branch points in its natural position of rest more or less horizontally-outward, it usually points ventrally under the coverglass. It seemed to me most convenient in describing these bristles to take their bearings as they are under the coverglass. „Ventrally“ is thus really laterally, „dorsally“ corresponds to medially.

short hairs, is of the tube-bristle type or is well pointed distally (the latter character varies even within the species). At or most frequently somewhat distally of the middle of this joint, laterally, there is a single bristle, in most cases about as long as or somewhat shorter than the former one, sometimes with short hairs, sometimes with rather long hairs at the middle, in most cases well pointed distally. One or two of the other bristles of this joint are situated ventero-medially at or somewhat proximally of half the length of the joint; a group (three to five) are situated ventrally often somewhat proximally of half the length of the joint; a group (two to four) are situated ventrally near the distal boundary of the joint. These bristles vary to a rather great extent both in number, length and type, not only from one species to another but also often within the same species; a larger or smaller number of them are always of the tube-bristle type; sometimes they all have short hairs, sometimes one or more of them have rather long hairs at the middle. Second joint: The three bristles on this joint are either subequal or else the dorsal one is slightly shorter or longer than the two ventral ones; they are in most cases about as long as or somewhat shorter than this joint, always with short hairs and are most frequently of the tube-bristle type. Of the three bristles on the end joint the middle one is rather powerful, in most cases about as long as or somewhat longer than the second exopodite joint, finely pectinated. (Its point — like the points of the two claws on the endopodite — is of about the same type as is reproduced in my fig. 28 of *C. symmetrica.*) The two other bristles on the end joint have short hairs and are tube-bristles; the dorsal one is in most cases about as long as or rather slightly shorter than the middle claw, the ventral one is most frequently about as long as or somewhat longer or shorter than half the length of the middle claw. The normal type of this limb described above agrees fairly closely with my fig. 27 of *C. symmetrica.* The pilosity varies on this limb, sometimes even within the species.

S i x t h l i m b: — For the same reasons as in the case of the mandible, maxilla and fifth limb it seemed to me most convenient to give here in the genus description an account of the „normal type" of this limb found by me; consequently in the following descriptions of species only such characters are included as differ more or less essentially from this type.

Contrary to the immediately preceding limbs this one shows rather great dimorphism.

M a l e: — This is large and powerful with very powerfully developed musculature and is used as an auxiliary organ in swimming. The p r o t o p o d i t e is in most cases unjointed, sometimes it shows a more or less distinct division into two joints. The e n d o p o d i t e is only partly joined to the protopodite; remains of its musculature can be observed. In most cases it has two (in exceptional cases one) bristles, which are most frequently subequal and about as long as the proximal height of the first exopodite joint, in most cases well pointed and with rather long hairs at the middle, short hairs distally. E x o p o d i t e: First joint: This joint usually has dorso-distally a short tube-bristle with short hairs. In exceptional cases this bristle is not found. Laterally, somewhat disto-dorsally of the middle of this joint, there is usually a single bristle, in most cases somewhat shorter than the distal height of this joint and in most cases furnished at the middle with rather long hairs and with short hairs distally; it has a fine point. This bristle may in rare cases also be missing. More or less scattered along the distal part of the ventral side, partly somewhat medially and partly somewhat

laterally, there are usually five (in exceptional cases four or six) bristles, of somewhat different lengths, the longest being in most cases as long as or somewhat longer or shorter than the proximal height of this joint, the shortest in most cases about half as long. These bristles are most frequently well pointed and either have short hairs or else a larger or smaller number of them are furnished with rather long hairs at the middle; the latter character varies a good deal, often even within the species. In exceptional cases this joint may have no bristles at all. The second joint has ventrally, at or somewhat distally of the middle, a single short-haired bristle, in most cases of the tube-bristle type and most frequently about half as long as the height of this joint or still shorter. In exceptional cases it may be almost entirely reduced. The two bristles of the third joint are in most cases of about the same length and type as that of the preceding joint. In exceptional cases the ventral one of them may be almost completely reduced or even quite absent. The three bristles of the end joint are usually subequal and about as long as the exopodite. All of them are usually furnished with rather long and powerful natatory hairs along the distal two-thirds of their length; in exceptional cases the ventral one has short hairs. It ought perhaps to be specially pointed out that these bristles are not modified distally as sensory organs. This limb is in most cases quite bare. The fig. 29 of *C. symmetrica* given by me below agrees fairly well with the „normal type" described here.

F e m a l e: — This is rather considerably smaller and weaker than that of the male; the musculature especially is considerably less strongly developed. In order to show the relative sizes it may be pointed out here as an example that whereas the exopodite of this limb (excluding, of course, the end bristles) is about 1,5 mm. long in males of *C. symmetrica* 4,0—4,1 mm. long, this branch measures only 1,0—1,1 mm. in females of the same species whose shells are 4,3 to 4,5 mm. long. Apart from this fact this limb differs from that of the male chiefly in the bristles of the exopodite. These are developed in the following way: First joint: The dorso-distal bristle has, as in the male, short hairs, and is in most cases about as long as or somewhat shorter than half the length of this joint. There are five bristles ventrally on this joint; two of these are situated at or somewhat proximally of half the length of this joint, one somewhat medially, the other somewhat laterally, the three remaining ones are near the distal boundary of this joint. These five bristles, like the single bristle situated laterally, somewhat dorso-distally of the middle of this joint, are better developed than in the male, in most cases subequal, about as long as or somewhat shorter than this joint and are all often furnished with rather long hairs at the middle and short hairs distally. Both the two bristles of the endopodite and these last-mentioned six bristles are most frequently well pointed, the short dorso-distal bristle is in most cases of the tube-bristle type, the latter sometimes with a rather long end hair (as in my fig. 26 of *C. symmetrica*). The bristles of the second and third joints are most frequently subequal and somewhat shorter than the second joint; they have short hairs and are in most cases of the tube-bristle type. The three bristles of the end joint are in most cases of about the same type and length as the corresponding bristles on the fifth limb but they are all in most cases somewhat longer comparatively. The middle one is most frequently about one and a half times as long as the second exopodite joint or somewhat longer. The fig. 30 of *C. symmetrica* given by me below agrees fairly well with the „normal type" described here.

Seventh limb: — The longest bristle is about a third or a quarter of the length of the shell, but varies to some extent even within the species. This limb is in most cases smooth; in exceptional cases the end joint is furnished with spines.

The penis varies rather considerably in type. Disto-laterally on the penis, somewhat ventrally of half the height of the organ and just proximally of the distal, forward bending part of the vas deferens, there is in most cases a lamelliform copulatory appendage, which is differently developed in different species.

Furca: — This has eight claws. The armature of the claws is in most cases moderately strong. Between the first and second claw there is no verruciform process. Behind the claws there is sometimes an unpaired bristle which varies somewhat in length. The lamellae are in most cases furnished with groups of short and stiff hairs on the inside.

Rod-shaped organ: — This shows more or less marked dimorphism.

Male: — This is always large, in most cases longer than the first antenna (the latter, of course, measured without its bristles). It consists of three parts which are moveably joined to each other. The middle one of these is rather firmly joined to the first antenna by means of the dorsal bristle on the second joint of this limb (retinaculum). The two proximal joints, between which the boundary runs at about the boundary between the two proximal joints of the first antenna, point forward, and are of about the same thickness throughout their length. The distal part, which is always somewhat thicker than the two proximal parts, points in most cases more or less ventrally; in addition it is in most cases armed with spines, principally along the ventral (posterior) side.

Female: — This organ is developed very differently in the female; in most cases it is somewhat shorter than in the male. Division into joints is most frequently less distinct than in the male. The boundary between the first and second joints is sometimes indicated, but in most cases it is quite absent. The distal part is most frequently somewhat thicker than the proximal part and in most cases, as in the male, it is armed with spines. The organ is not joined to the first antenna by a retinaculum, but is quite free.

Upper lip: — This projects strongly; when seen from the side it forms in most cases a rather pointed angle anteriorly (see my fig. 36 of *C. symmetrica*); its anterior side has no verruciform swellings. The glands of the upper lip have their exits scattered on the ventral side of the upper lip, arranged on the whole, however, in two longitudinal rows running on each side of and at some distance from the middle line. The postero-ventral margin of this lip varies somewhat in shape, but it is as a rule somewhat more rounded than in the genus *Halocypris*; its combs project moderately and are furnished with rather numerous and rather powerful hairs. In the inner corner of each of these combs one or two glands have their exits. The part between these combs is most frequently somewhat narrower than each of the combs, but otherwise it varies in shape, being sometimes more or less straight and sometimes having a more or less deep notch at the middle.

The paragnates are in most cases more or less oval (cf. my fig. 38 of *C. symmetrica*) or else somewhat more triangular (cf. my fig. 14 of *C. rotundata*); they often vary, however, even within the species. The chitinous lists behind the under lip are of the type reproduced by G. W. MÜLLER, 1894, pl. 35, fig. 15; cf. my fig. 35 of *C. symmetrica*.

Special terminology: — First antenna: — For the five bristles on the two distal joints I have used the same alphabetical notation in this genus as I did for the genus *Halocypris* above. Thus the two bristles of the next to the distal joint are denoted by a and b; here in the male the hyaline sensorial filament is denoted as the a-bristle, the long, ordinary bristle as the b-bristle. The disto-anterior of the three bristles on the end joint is denoted as the e-bristle, the two others as the c- and d-bristles, the long ordinary bristle in the male being denoted as the d-bristle, the remaining one, the hyaline sensorial filament, as the c-bristle.

Mandible: — As in the case of the genus *Halocypris* so in this genus the bristles denoted by C. CLAUS as „Stachelzähne" are termed lancet-bristles.

Fifth limb: — Those of the bristles on the first exopodite joint that are situated medio-ventrally, in most cases somewhat proximally of half the length of the joint, are called „the medio-ventral bristles", the ventral group of bristles at or somewhat proximally of half the length of the joint are called „the proximo-ventral" bristes and the ventral group near the distal boundary of this joint are termed „the disto-ventral" bristles.

Rod-shaped organ: — The distal part of this organ, which is, at least in the males, in most cases well marked off, and which is called by G. W. MÜLLER „Endstück", is called in the present work „capitulum", after the example of G. S. BRADY and A. M. NORMAN. The part situated proximally of the capitulum is called the shaft.

Spinifera group G. W. MÜLLER

(= *Paraconchoecia* [part.] C. CLAUS).

Number of species. C. CLAUS, 1891 a, included in the genus *Paraconchoecia*, besides the species *Conchoecia oblonga* dealt with below, the following species:

Conchoecia spinifera, (C. CLAUS), 1891 a, p. 64; pl. X.
„ *inermis*, „ „ 1891 a, p. 65; pl. XI.
„ *gracilis*, „ „ 1891 a, p. 66; pl. XII.

All these species, except *C. gracilis*, which appeared to be a synonym of *C. elegans* G. O. SARS, are included by G. W. MÜLLER, 1906 a, in the *Spinifera* group established by him. In addition this writer adds the following species to this group in the work just mentioned:

Conchoecia allotherium, G. W. MÜLLER, 1906 a, p. 59; pl. XI, figs. 15—19.
„ *aequiseta*, „ „ „ 1906 a, p. 59; pl. XI, figs. 1—6, and 11—14.
„ *hirsuta*, „ „ „ 1906 a, p. 60; pl. XI, figs. 1—3 and 6—10.
„ *mamillata*, „ „ „ 1906 a, p. 60; pl. XVI, figs. 1—9; pl. XXXV, fig. 8.
„ *echinata*, „ „ „ 1906 a, p. 61; pl. X, figs. 14—24.
„ *dorsotuberculata*, „ „ „ 1906 a, p. 63; pl. X, figs. 1—3 and 8—13.
„ *reticulata*, „ „ „ 1906 a, p. 64; pl. XII, figs. 10—17.

Conchoecia caudata. G. W. MÜLLER, 1906 a, p. 65; pl. XI, fig. 24 and pl. XII, figs. 1—9.

.. *dasyophthalma.* .. .. .. 1906 a, p. 66; pl. XI, figs. 20—23 and 26—30.

Is this group a natural one?

A criticism of this group.

As I was only able to investigate closely one of the above-mentioned species it is exceedingly difficult for me to decide this question on account of the incompleteness in the descriptions of these forms. It seems to me, however, fairly certain that it must be answered in the negative.

Both G. W. MÜLLER's characterization of this group and C. CLAUS's diagnosis of the genus *Paraconchoecia* are exceedingly incomplete and leave the reader anything but convinced as to the justification of including the species in question in one group. G. W. MÜLLER himself states (1906 a, p. 52) that it is not possible to define precisely and characterize this group. — In order still further to explain this fact I shall give here a critical exposition of the characters put forward by these writers.

Shell: — According to C. CLAUS this is „sehr zart und stark comprimiert, meist mit einem Stachelfortsatz am Hinterende der rechten Klappe". G. W. MÜLLER only adopts the last of these characters; according to the latter writer the shell is characterized, in addition, by the fact that the unsymmetrical glands emerge for the most part „at the usual place" and by the absence of lateral groups of glands.

With regard to these characters the following facts may be stated: The species of this group that I investigated, namely *C. oblonga*, is not characterized by a more thin-walled shell than many other species belonging to other groups of this genus. — The shells of species in this group are not, or at least not essentially, narrower than in most other species of this genus. — These two characters were, as has been pointed out above, not included by G. W. MÜLLER. — The posterior dorsal corner of the right valve is armed with a more or less well developed spine not only in a rather large number (nineteen) of species belonging to several other groups of this genus but also in representatives of two of the three other genera of this family, namely *Archiconchoecia* and *Euconchoecia*. In addition, an armature of this kind is, as both C. CLAUS and G. W. MÜLLER have pointed out, not characteristic of all the species in the group under consideration here; both *C. inermis* and *C. dorsotuberculata* have no spines at all either on the left or the right valve. It is also to be noted that we are here concerned with a character that sometimes varies even within the species, a fact that G. W. MÜLLER himself has observed; cf. this writer's work 1906 a, p. 53. — The fact that the unsymmetrical glands have their exits „an der gewöhnlichen Stelle" is, of course, a character of little value. This character, which is found in most species of the genus *Conchoecia*, is presumably an original one in this genus, as is shown with a fairly great degree of certainty by the fact that these glands also have this position in the genus *Halocypris*. Moreover these glands have, as G. W. MÜLLER himself has pointed out, been rather considerably displaced in not less than four species of this group, namely *C. aequiseta*, *C. hirsuta*, *C. dorsotuberculata* and *C. mamillata*. — The absence of lateral groups of glands in these species is certainly also primitive. Such groups of glands are only found in the genus *Conchoecia*; in all other genera of this sub-family they are always absent. In the genus *Conchoecia* there are

no lateral corner glands, not only in the species of this group, but in no less than 23 species belonging to several different groups.

First antenna: — It is especially on this antenna that G. W. MÜLLER bases his grouping together of the species mentioned above. „Characteristisch für die Gruppe ist die Bewaffnung der Hauptborste in beiden Geschlechtern" (1906 a, p. 56). In the females of these species the e-bristle on this antenna is furnished with „langer, dünner, stark abstehender Behaarung am Vorderrand". There are no such hairs in *C. dasyophthalma*; this species is consequently included here only with hesitation.

It is probably best, however, not to attach too much importance to this character, as I have observed that similar hairs are characteristic of the female of *C. spinirostris* as well, i. e. a species that G. W. MÜLLER referred, though with hesitation, to quite another group of this genus, namely the *Magna* group, and they are also found in *C. obtusata**. Does *C. spinirostris* belong to the *Magna* group or is this doubt of G. W. MÜLLER's justified? It seems to me, unfortunately, impossible to answer this question on account of the comparatively slight knowledge I possess of the majority of the species belonging to the *Magna* group. On the other hand it seems to me beyond all doubt that *C. spinirostris* is not more closely related to *C. oblonga* than many other species belonging to other groups of this genus. Anyone who knows *C. obtusata* and *C. oblonga* will understand that there is no specially close relation between these two species.

In the males of the *Spinifera* group the e-bristle is furnished with „langen, borstenartigen Spitzen; dieselben stehen meist sehr dicht, rücken nur ausnahmsweise *(echinata)* etwas weiter auseinander; distal von den basalwärts gerichteten Borsten findet sich meist (Ausnahme *dorsotuberculata*, *allotherium*, *mamillata*) eine kleine Gruppe distalwärts gerichteter Börstchen" (G. W. MÜLLER, 1906 a, p. 56).

With regard to these characters it may be pointed out, first, that long, bristle-like, close spines are not characteristic only of species of this group, but of a very large number of species belonging to several other groups of this genus; we are presumably concerned here, too, with a comparatively primitive character; cf. also this character in *C. dasyophthalma*, pl. XI, fig. 30. Nor is the character of a small group of distally pointing spines situated distally of the rows of spines confined to this group; similar spines are found in several other species of this genus belonging to different groups; the exceptions within the groups are also, of course, considerably numerous. Nor can the armature of the b- and d-bristles as put forward by G. W. MÜLLER be conveniently used; there are exceptions within the group and we find a similar character in a very large number of species in many other groups of this genus.

Mandible: — „Kauwulst der Mandibellade in Form einer quergestellten dreiseitigen Zahnplatte über die ganze Breite der Kaufläche ausgezogen, die vier Hakenzähne zur Seite gedrängt, in dem dichten Borstensaum mehr oder minder versteckt." (C. CLAUS, 1891 a.) This character is not included at all by G. W. MÜLLER. With regard to the value of this character, which applies, of course, only to the three first-mentioned species, it is difficult to make any definite statement, but it is presumably rather slight, as the differences we are concerned with

* In a large number of species there are exceedingly short, distally pointing hairs at this place. Such species are *C. elegans*, *C. rotundata*, *C. Haddoni*, *C. bispinosa*, *C. Gaussi*, *C. serrulata* and *C. Chuni*.

here are too small to enable us to ascribe any great importance to them. In this connection I will only quote G. W. MÜLLER's statement, 1906 a, p. 52: „Der Versuch von CLAUS, den Bau des Kaufortsatzes der Mandibel einer weiteren Einteilung zu Grunde zu legen, scheint mir nicht durchführbar."

These writers have not taken other organs into consideration in making this classification. Purely from the point of view of habitus this group includes rather heterogeneous elements; cf., for instance, *C. caudata*, *C. dasyophthalma* and *C. oblonga*.

Is not *C. decipiens*, for instance, which belongs to the *Procera* group, considerably more closely related to *C. oblonga* than the latter is to, for instance, *C. dasyophthalma* or *C. caudata*?

As has been pointed out above, no answer as to the naturalness of this group can yet be given. For this a new and comprehensive investigation of the species in it is necessary.

Conchoecia oblonga (C. CLAUS).

Paraconchoecia oblonga, C. CLAUS, 1890, p. 13.
Conchoecia variabilis (part.), G. W. MÜLLER, 1890 a, p. 273; pl. XXVIII, figs. 27 and 38.
Paraconchoecia oblonga, C. CLAUS, 1891 a, p. 63; pl. VIII, figs. 10 and 11; pl. IX.
Conchoecia oblonga, G. W. MÜLLER, 1906 a, p. 58; pl. IX, figs. 11—13, 16—25.
,, ,, ,, ,, ,, 1906 b, p. 3.
,, ,, V. VÁVRA, 1906, p. 38; pl. II, figs. 21—28.
,, ,, G. W. MÜLLER, 1908, p. 66.
,, ,, ,, ,, ,, 1912, p. 69.

(Non *Paraconchoecia oblonga*, C. CLAUS, 1894, p. 3; *P. oblonga*, P. T. CLEVE, 1900, p. 40 and *Conchoecia oblonga*, G. W. MÜLLER, 1890 a, p. 272.)

Description: — See C. CLAUS, 1891 a, p. 63 and G. W. MÜLLER, 1906 a, p. 58.

Supplementary description: — Male: —

Shell: — Length, according to G. W. MÜLLER, 1906 a, „ziemlich konstant 1,45 mm.", according to V. VÁVRA, 1906, 1,2—1,3 mm. The lengths of the specimens investigated by me varied between 1,40 mm. and 1,6 mm. Length : height about 2,3 : 1; length : breadth about 2,3 : 1. Seen from the side it has about the same type as is reproduced in the accompanying figure 1, i. e. the posterior part of the shell is not larger than the anterior part. With regard to this characteristic the specimens investigated by me differed from the type reproduced by G. W. MÜLLER, 1906 a, in pl. IX, fig. 11. (This figure certainly represents a female, but G. W. MÜLLER does not mention the existence of any difference between the sexes in this respect; cf. under the description of the female shell below.) On the other hand the figure of the male shell in this species given by C. CLAUS, 1891 a, pl. IX, fig. 9 agrees in this respect with the type found by me. Seen from below, fig. 2, it has its greatest breadth at or just in front of the middle, its side contours are uniformly curved, it is broadly rounded anteriorly with a rostrum that is almost symmetrical, and is pointed posteriorly. The shoulder vault is always powerful, but was never sharp-edged in the specimens investigated by me. The

spine at the posterior corner of the right valve is always developed and in the specimens investigated by me it was bounded off by a decided angle from the posterior margin of the shell; cf. fig. 3. When the shell is seen from the side the margin of the shell has, just ventrally of the rostral incisur, a sort of spine-like process. This process is, as C. CLAUS has already pointed out, formed by the selvage, which is rather broadly convex at this point; when this part of the selvage is seen from inside it is well rounded; see fig. 4. Seen from inside: Apart from this the selvage in this species is characterized by the fact that it is smooth-edged or only exceedingly finely serrulated along the anterior margin of the shell and the anterior half of the ventral margin of the shell; it is finely serrulated along the posterior half of the ventral margin of the shell and a short distance of the most ventral part of the posterior margin of the shell; inside the remaining part of the ventral half of the posterior margin of the shell the marginal spines of the selvage are somewhat larger, but they never seem to be developed quite in the same way as in the accompanying fig. 4 of *C. symmetrica*. The selvage has no large spine-like processes on the rostrum. There are a few rather long, soft hairs scattered on the surface of the shell. With regard to the position of the glands the specimens investigated by me belonged to the type denoted by G. W. MÜLLER, 1906 a, as „Form a". The medial glands along the posterior margin of the shell are moderately large; their exits are always simple, arranged in a distinct row running about half way between the selvage and the edge of the shell or else somewhat nearer the latter, but not joined by any distinct list. There is no distinctly developed hinge-socket or hinge-tooth at the posterior dorsal corner of the shell.

First antenna: — E-bristle: The proportion between the length of this bristle and the length of the whole limb is about 4 : 3. Somewhat distally of the middle this bristle has two rows of proximally pointing spines along about a quarter of its length. The number of spines in these rows seems to be subject to rather slight variation: about thirty or slightly fewer were found in each row. (V. VÁVRA, 1906, p. 38, gives the number as only 26; there are 28 in the figure given by this writer.) As G. W. MÜLLER has pointed out, all these spines, even those situated most proximally, are close together. In most cases the spines in the two rows are situated about opposite to each other, at any rate they do not distinctly alternate. All these spines seem to be narrow and well pointed; those situated distally are rather short, about as long as the thickness of the bristle at the place where they are attached, the others increase fairly uniformly in length the more proximally they are situated, the most proximal ones being rather long, from about three to five times as long as the distal ones. Just distally of these rows of spines this bristle is furnished with a few short spines, which in most cases point somewhat distally. (Most frequently they are of about the same type as the spines distally of the suctorial plate on the e-bristle of *C. elegans*; cf. the accompanying fig. 15 of the latter species.) Just distally of these spines this bristle is bent at a decided angle. The part of the bristle situated distally of this knee is bare and, as has been pointed out by G. W. MÜLLER, not widened. The anterior side of this bristle is quite bare. The b- and d-bristles are subequal, somewhat shorter than or about as long as the e-bristle, often bent at a rather decided angle at about the corresponding place to that in the last-mentioned bristle; they are not widened distally. As G. W. MÜLLER has pointed out, the b-bristle is furnished with a dense row of (about ten to twenty) rather short

and fine distally pointing spines, about the same as are shown in pl. IX, fig. 7 in G. W. MÜLLER's work, 1906 a; this row of spines is sometimes divided into two. The d-bristle has at the corresponding place a sparse row of similar spines. None of these three bristles have pad-like formations. The a-bristle is about as long as or somewhat longer than the total length of the four distal joints; it has no accessory saccule. The c-bristle is quite short, only about as long as the distal height of the second joint. The e-bristle is more or less straight, the d-bristle is in most cases not decidedly rolled up. All the joints are quite bare.

S e c o n d a n t e n n a: — P r o t o p o d i t e: In specimens with shells 1,4—1,5 mm. long this attained a length of about 0.75 mm. E x o p o d i t e: The proportion between the length of this branch and that of the protopodite is about 14 : 30. The proportion between the length of the first joint and the total length of the eight following joints is about 2 : 1. The

Fig. CXVI. — *Conchoecia oblonga* C. CLAUS. — 1. Shell seen from the side, ♂; 56 ×. 2. Shell seen from below, ♂; 49 ×. 3. Postero-dorsal corner of the shell seen from inside, ♂; 133 ×. 4. Margin of the left valve just below the incisur seen from inside, ♂; 567 ×. 5. Postero-dorsal corner of the shell seen from inside, ♀; 133 ×. 6. Clasping appendage of the endopodite of the right second antenna, ♂; 400 ×. 7. Proximal tooth-list of the right mandible seen from inside, ♀; 1167 ×. 8. Distal part of the penis, seen from outside; 833 ×. 9. The fourth to the seventh claws of the furca, ♂; 420 ×. 10. Distal part of the rod-shaped organ, ♂; 187 ×. 11. Distal part of this organ + a part of the first antenna, ♂; 187 ×. All the figures are drawn from specimens from Station 20 b.

proportion between the length of the longest natatory bristles and that of the exopodite is about 4 : 3. The first joint is furnished proximo-distally with a dense longitudinal row of short, fine spines along about a quarter or a third of its length and close to this row there is a larger or smaller number of scattered spines of the same type (about the same as in figs. 12 and 13 of *C. symmetrica*). E n d o p o d i t e: First joint: The processus mammillaris has no distal verruca. The a- and b-bristles have no long hairs, in most cases they are quite bare. Second joint: The c- and d-bristles are most often somewhat shorter than this joint and have short fine hairs or are almost quite bare. The e-bristle is exceedingly short. The g-bristle is about as long as or slightly shorter than the protopodite; it grows gradually narrow distally and is furnished with rather sparse short fine hairs. The f-bristle is about a quarter or a third shorter than the g-bristle and, like it, is not widened distally and is bare. Third joint: The clasping organs are of about the same types as are reproduced by G. W. MÜLLER, 1906 a, pl. IX, figs. 22 and 23 (see the adjoining fig. 6). The h-, i- and j-bristles are subequal, in most cases somewhat less than half the length of the g-bristle; along the greater part of their length they are about as wide as the proximal part of the f-bristle; they are only slightly widened proximally and have only indications of shafts; they are bare.

M a n d i b l e: — P r o t o p o d i t e: Coxale: The number of teeth on the toothed edge of the pars incisiva varied between seven and ten in the specimens investigated by me. Distal tooth-list: This is rather slightly narrower than the toothed edge of the pars incisiva and is of about the type reproduced by me in fig. 17 of *C. symmetrica*, but somewhat variable. It is armed with a simple row of about 14—18 teeth. The two posterior ones of these teeth are rather high and powerful, the posterior one of them is in most cases smooth, the other is most frequently furnished with a few small secondary teeth. The others, 12—16, are somewhat lower than the former ones and are smooth; they are either subequal and somewhat rounded distally (about the same as the middle teeth in the figure just mentioned) or else the anterior ones are somewhat larger and wider than the others (about the same as in the figure just mentioned). Proximal tooth-list: This is rather slightly narrower than the distal one and is armed with a somewhat varying number (about 14—20) of teeth, arranged in a simple row. As in the case of the distal tooth-list, the two posterior of these are rather high and powerful, like tusks, the others vary rather as to their development, being sometimes of about the same type as the corresponding teeth on the distal tooth-list, sometimes of other types, as, for instance, those shown in the adjoining fig. 7. This tooth-list is furnished on the inside with numerous fine, short spines, situated close together. The masticatory pad is simple or at any rate without any distinct division into lobes; it is comparatively wide, about as wide as the tooth-lists; it is square distally and is armed with exceedingly numerous rather small spines. The lancet-bristles are, as C. CLAUS pointed out, 1891 a, p. 63 „in dem dichten Borstensaum mehr oder minder versteckt". Basale: The six teeth on the distal edge of the endite are furnished with exceedingly fine serrulation. The single tooth on the outside of this process is of about the same size and type as in my fig. 19 of *C. symmetrica*, finely serrated only along the distal half of the anterior edge. The e p i p o d i a l a p p e n d a g e is represented only by an exceedingly small (scarcely observable with REICHERT's ocular 4, LEITZ's immersion $^1/_{12}$) verruciform process.

E n d o p o d i t e: The first joint has three posterior bristles, all with short hairs. The lateral one of these bristles is about as long as or somewhat longer or shorter than the two distal endopodite joints, the two others are somewhat shorter.

M a x i l l a: — P r o t o p o d i t e: The bristle on the basale is relatively short, only about half as long as the first endopodite joint; in exceptional cases it has at the middle a few rather long secondary bristles. E n d o p o d i t e: A couple of the six bristles on the anterior edge of the first joint are usually furnished with rather long, stiff secondary bristles at the middle. On the posterior edge of this joint there are two or three bristles, in most cases three. The ventral side of the end joint is about as long as the breadth of the first endopodite joint distally (calculated from front to back); its dorsal side is about half as long.

F i f t h l i m b: — P r o t o p o d i t e: The longer of the two tube-bristles on the second endite is always furnished at the middle with rather long, stiff secondary bristles. E n d o p o d i t e: One of the three ventero-anterior bristles is of about the same length and type as the long bristles on the endites of the protopodite, the two others are somewhat shorter and weaker (about the same proportions as in my fig. 27 of *C. symmetrica*) and have short hairs. This branch has no spine armature. E x o p o d i t e: First joint: This has two medio-ventral bristles, often subequal and about as long as the proximal height of this joint, and with short hairs. There are three or four bristles in the proximo-ventral group; these are somewhat different in length, the longest being in most cases about as long as or somewhat longer than the two medio-ventral bristles, the shortest about half as long; the longest of these bristles has in most cases rather long hairs at the middle, the others most frequently have short hairs. The disto-ventral group of bristles consists of two or three short-haired bristles of somewhat different lengths; their lengths vary in most cases within the same limits as in the case of the bristles in the proximo-ventral group. The dorso-lateral bristle is furnished with long hairs. Pilosity: The protopodite and the first exopodite joint have sparse hairs medially, but apart from these this limb always seems to be bare.

S i x t h l i m b: — E x o p o d i t e: The ventral bristles on the first joint are perhaps on the average somewhat shorter than in my fig. 29 of *C. symmetrica*; they all have rather long hairs at the middle as is the case with the dorso-lateral bristles on this joint. The ventral bristle on the end joint has short hairs.

P e n i s: — This is comparatively narrow and has about the same height throughout its length; it is obliquely rounded off distally; cf. pl. IX, fig. 13, C. CLAUS, 1891 a. At about the middle there is a series of about five or six oblique transverse muscles; there are no muscles distally of these. It has a rather large, distally rounded, copulatory appendage; cf. the adjoining fig. 8.

F u r c a: — The fifth claw is unusually decidedly bent; see pl. IX, fig. 2, C. CLAUS, 1891 a and my fig. 9. There is no unpaired bristle behind the claws.

R o d - s h a p e d o r g a n: — The shaft reaches to about the proximal boundary of the third joint of the first antenna or to the point of this limb. The capitulum is about as long as the second joint of the first antenna; in the specimens investigated by me this part was of about the type reproduced in the accompanying fig. 10, i. e. of about the same type as was found by C. CLAUS.

Upper lip: — The part between the combs on the postero-ventral edge of this lip is slightly concave, about the same as in my fig. 37 of *C. symmetrica*. The paragnates are about the same as in the latter species.

Female: —

Shell: — Length: According to G. W. MÜLLER, 1906 a, this is 1,6—1,8 mm. (C. CLAUS, 1891 a, gives a length of 1,4—1,5 mm., but makes no distinction between males and females in this respect.) The lengths of the specimens investigated by me varied between 1,5 and 1,8 mm. Length : height about 2,5 : 1; length : breadth about 3 : 1. In other respects we find about the same type as in the male, both when seen from the side and from beneath; it is, however, to be noted that the shoulder vault is not quite so powerful and the shell, when seen from the side, is somewhat higher than in the male; among the specimens investigated by me, however, there was none that was so high posteriorly as the type reproduced by G. W. MÜLLER, 1906 a. The spine on the postero-dorsal corner of the right valve is not bounded off from the posterior margin of the shell by a distinct angle; see fig. 5. In other respects it resembles the male.

First antenna: — This is of the type described by G. W. MÜLLER. The bristle of the second joint has exceedingly fine, short hairs, almost bare. All the joints are bare. In the first joint there are a large number of yellowish-brown corpuscles (explained by some previous writers as reduced eyes).

Second antenna: — The protopodite is only slightly relatively shorter than that of the male. The proportion between the length of the protopodite and that of the exopodite is about the same as in the male. Endopodite: This has three joints; the little end joint is clearly defined. The g-bristle is slightly relatively shorter than in the male. The f-, h-, i- and j-bristles are subequal or differ only slightly in length; they are somewhat more than half the length of the g-bristle. These four bristles are of about the same type as in the male. Between the h- and i-bristles there is an exceedingly short bristle, which is only perceptible with very great magnification (REICHERT's ocular 4, LEITZ's immersion $^1/_{12}$). Pilosity: The second endopodite joint is bare.

The rod-shaped organ is quite of the type found by C. CLAUS and G. W. MÜLLER; see the accompanying fig. 11.

Synonymy

Remarks: — It seems to me beyond all doubt that the form *Paraconchoecia oblonga* described by C. CLAUS, 1890 and 1891 a, is identical with the species dealt with by me above. Almost entire agreement was observable between the specimens investigated by me and the fairly full description given by this writer. It is true that a number of differences can be observed, e. g. with regard to the e-bristle of the female first antenna and the fifth and sixth limbs, but these differences seem certainly to be due to the somewhat superficial nature of this author's description.

Nor does there seem to be the least doubt that *Conchoecia oblonga*, V. VÁVRA, 1906, is identical with this species. An almost detailed agreement is found between this author's description and the information given by me above. V. VÁVRA's statement that the capitulum of the male rod-shaped organ is bare („ganz kahl") is contradicted by this writer's pl. II, fig. 23.

The great resemblance between V. VÁVRA's and my figures of the male shell and the rod-shaped organ ought specially to be pointed out.

It also seems to me quite certain that G. W. MÜLLER's species *C. oblonga*, 1906 a, comprises the species dealt with here. On the other hand it seems less certain that the material investigated by G. W. MÜLLER for this work was pure from a systematic point of view. With regard to the shell this writer distinguished two forms, which he termed a and b, and the rod-shaped organ in the males investigated by him was subject to rather far-reaching variation. This is particularly noteworthy because neither C. CLAUS nor V. VÁVRA mention any variation although they had abundant material at their disposal; C. CLAUS writes, for instance, with regard to this species . . . „die in zahlreichen Exemplaren untersucht werden konnte und zu den am besten charakterisirten Formen gehört", 1891 a, p. 64, and V. VÁVRA found and investigated this species from no less than 39 different stations.

Nor have I observed any variation in this species myself; on the contrary the specimens investigated by me agreed well with the types described by C. CLAUS and V. VÁVRA, as I have pointed out above; we must note, however, in this connection that the material investigated by me contained only a small number of specimens of this species. I have nevertheless accepted the definitions made by G. W. MÜLLER, because this writer put forward reasons (1906 a, p. 58) that seem to support fairly decidedly the idea that we are concerned with a species with a rather great amplitude of variation.

C. CLAUS in his work of 1891 a, p. 64 identified the species *Conchoecia variabilis* described by G. W. MÜLLER, 1890 a with this species; as C. CLAUS himself pointed out, however, this identification was very uncertain because of the incompleteness of G. W. MÜLLER's description. In a later work, 1906 a, G. W. MÜLLER himself accepted this identification, but with the reservation that only a number of the specimens investigated by him (1890 a) were identical with this form.

It is impossible to decide whether *Paraconchoecia oblonga*, G. S. BRADY, 1897, p. 95 is identical with the species dealt with above. It is true that this writer gives a couple of figures, pl. XVII, figs. 20 and 21, but they are so incomplete that no conclusions in this direction can be drawn from them.

This species is also mentioned in G. S. BRADY and A. M. NORMAN's work of 1896, but we only find here a translation of the information previously given by C. CLAUS.

That *Paraconchoecia oblonga*, C. CLAUS, 1894 is not identical with the species dealt with above is shown quite clearly both by this writer's description and his figures. This form is, as G. W. MÜLLER has already previously pointed out, presumably identical with *Conchoecia procera* G. W. MÜLLER. For *P. oblonga* P. T. CLEVE see the remark under *Euconchoecia Chierchiae* below; for *Conchoecia oblonga*, G. W. MÜLLER, 1890 a, see this writer 1906 a.

The name *Conchoecia* (or *Paraconchoecia*) *oblonga* (C. CLAUS) is also mentioned in the following places in the literature: C. CLAUS, 1893, p. 286, G. S. BRADY, 1902 a, p. 199 (— 1903, p. 337 and A. M. NORMAN, 1905, p. 155), G. H. FOWLER, 1903, p. 121 and P. T. CLEVE, 1904, p. 370 and 1905, p. 132. As no descriptions or verificatory figures accompany these statements it did not seem to be convenient to include them in the list of synonyms given above.

Habitat. — Atlantic Ocean:

S. A. E., Pl. station 23, lat. 34° 2′ N., long. 18° 21′ W.; at the surface; 5. XI. 1901; temperature, 20,1° C.: 1 mature male, 2 mature females and 1 larva; R. M. S. 209. S. A. E., Pl. station 26, lat. 32° 21′ N., long. 19° 8′ W.; at the surface; 6. XI. 1901; temperature, 20,5° C.: 1 mature female; R. M. S., on slides. S. A. E., Pl. station 6 b, lat. 23° 35′ N., long. 22° 19′ W.; at the surface; 10. XI. 1901; temperature, 23° C.: 1 mature male; R. M. S. 206. S. A. E., Pl. station 8 b, lat. 21° 51′ N., long. 23° 0′ W.; at the surface; 11. XI. 1901; temperature, 23,2° C.: 1 mature female; R. M. S. 207. S. A. E., Pl. station 20 b, lat. 11° 9′ S., long. 32° 55′ W.; at the surface; 29. XI. 1901; temperature, 26,4° C.: 2 mature males and 3 mature females; R. M. S. 208.

Distribution: — Atlantic Ocean from lat. 37° N. (C. CLAUS, 1891 a, V. VÁVRA, 1906) to lat. 37° S. (G. W. MÜLLER, 1906 a). Indian Ocean to lat. 32° S. (G. W. MÜLLER, 1906 a).

The finds of the Swedish „Antarctic“ expedition are consequently within the limits of this species as stated by previous authors.

Elegans group G. W. MÜLLER.

This group is certainly quite a natural one. It comprises only two species, the one described below and *C. discophora*, which are very closely related to each other.

Conchoecia elegans G. O. SARS.

Conchoecia elegans, G. O. SARS, 1865, p. 117.
„ „ „ „ „ 1869, p. 360.
Paraconchoecia gracilis, C. CLAUS, 1890, p. 15.
„ „ „ „ 1891 a, p. 66; pl. XII.
Conchoecia elegans, G. S. BRADY and A. M. NORMAN, 1896, p. 684; pl. LX, fig. 23; pl. LXV, figs. 11—22.
„ „ E. VANHÖFFEN, 1897, p. 285.
„ „ O. NORDGAARD, 1898, p. 17.
„ „ and *C. quadrangularis*, C. W. S. AURIVILLIUS, 1898, pp. 16, 42, 218, 224, 230, 398, 400.
„ „ O. NORDGAARD, 1899, p. 26.
„ „ C. W. S. AURIVILLIUS, 1899, pp. 37, 58, 62, 66.
„ „ P. T. CLEVE, 1900, p. 39.
„ „ G. W. MÜLLER, 1901, p. 3, figs. 1—3.
„ „ H. H. GRAN, 1902, pp. 83, 210.
Paraconchoecia gracilis, G. S. BRADY, 1902 a, p. 199 (1903, p. 338).
Conchoecia elegans, TH. SCOTT, 1902 a, p. 476; pl. XXV, fig. 33.
„ „ „ „ 1902 b, pp. 514, 517.

Conchoecia elegans, P. T. CLEVE, 1903, pp. 19, 23.

„ „ P. T. CLEVE and O. PETTERSSON, 1903, pp. 2, 7.

„ „ TH. SCOTT, 1905, p. 228.

„ „ O. NORDGAARD, 1905, p. 40.

„ „ C. H. OSTENFELD, 1906, p. 96.

„ „ G. W. MÜLLER, 1906 a, p. 69; pl. XIII, figs. 10, 11, 19—26.

„ „ V. VÁVRA, 1906, p. 41; pl. II, figs. 37—40; pl. III; figs. 41—43.

„ „ G. W. MÜLLER, 1906 b, p. 4.

„ „ A. K. LINKO, 1907, p. 194.

Paraconchoecia gracilis, G. S. BRADY, 1907, p. 2.

Conchoecia elegans, E. KOEFOED, 1907, pp. 150, 151, 156, 157, 160, 161, 163, 164, 170, 175, 183, 187, 188, 189, 192, 193, 196, 204, 209, 210, 214, 215, 226, 232, 235, 249, 252, 258, 259, 269.

„ „ G. W. MÜLLER, 1908, p. 67.

„ „ C. H. OSTENFELD and C. WESENBERG-LUND, 1909, p. 113.

„ „ G. H. FOWLER, 1909, pp. 233, 263, 286.

„ „ C. APSTEIN, 1911, p. 164; pl. XXIII.

„ „ TH. SCOTT, 1912 a, p. 588.

„ „ E. JÖRGENSEN, 1912, pp. 14, 16.

„ „ G. W. MÜLLER, 1912, p. 72.

„ „ K. STEPHENSEN, 1913, p. 354.

Description: — See C. CLAUS, 1891 a, p. 66 and G. W. MÜLLER, 1901, p. 3; 1906 a, p. 69.

Supplementary description: — Male: —

Shell: — Length: C. CLAUS (1891 a) gives this as 1,2—1,3 mm. (the same for ♂ and ♀); G. S. BRADY and A. M. NORMAN, 1896: 1,4 mm.; V. VÁVRA, 1906: 1,5—2 mm.; G. W. MÜLLER, 1906 a and 1912: 1,0—2,0 mm., „die großen Individuen über . . . 1,8 mm. stammen aus der Arktis". The male specimens investigated by me had the following lengths: Skager Rak and Cattegat: 2,05—2,25 mm., Lofoten: 2,1—2,25 mm., Arctic Ocean, 2,05—2,2 mm., Atlantic Ocean (S. A. E., Pl. Station 134): 1,2 mm., Antarctic Ocean: 1,45—2 mm.; specimens from 1,85—2 mm. long were found only at the most southerly station (S. A. E., Pl. station 59 b). Length : height about 2,6 : 1; length : breadth about 2,9 : 1. Seen from the side it is of about the same type as is reproduced in the adjoining fig. 1, i. e. perhaps somewhat more elongated and with a posterior part that dominates somewhat less than would appear from the descriptions mentioned above. The spines just in front of the posterior dorsal corner of the right valve vary somewhat in number, from one to three were found. In the Scandinavian specimens the right valve always had at the postero-dorsal corner a process of about the type reproduced in the accompanying fig. 3; in the male specimens from the Antarctic Ocean investigated by me there was never any such process; see the accompanying fig. 4. Seen from below (fig. 2), it has its greatest breadth at about the middle and has side contours that are somewhat irregularly and weakly undulating posteriorly; anteriorly it is broadly rounded with

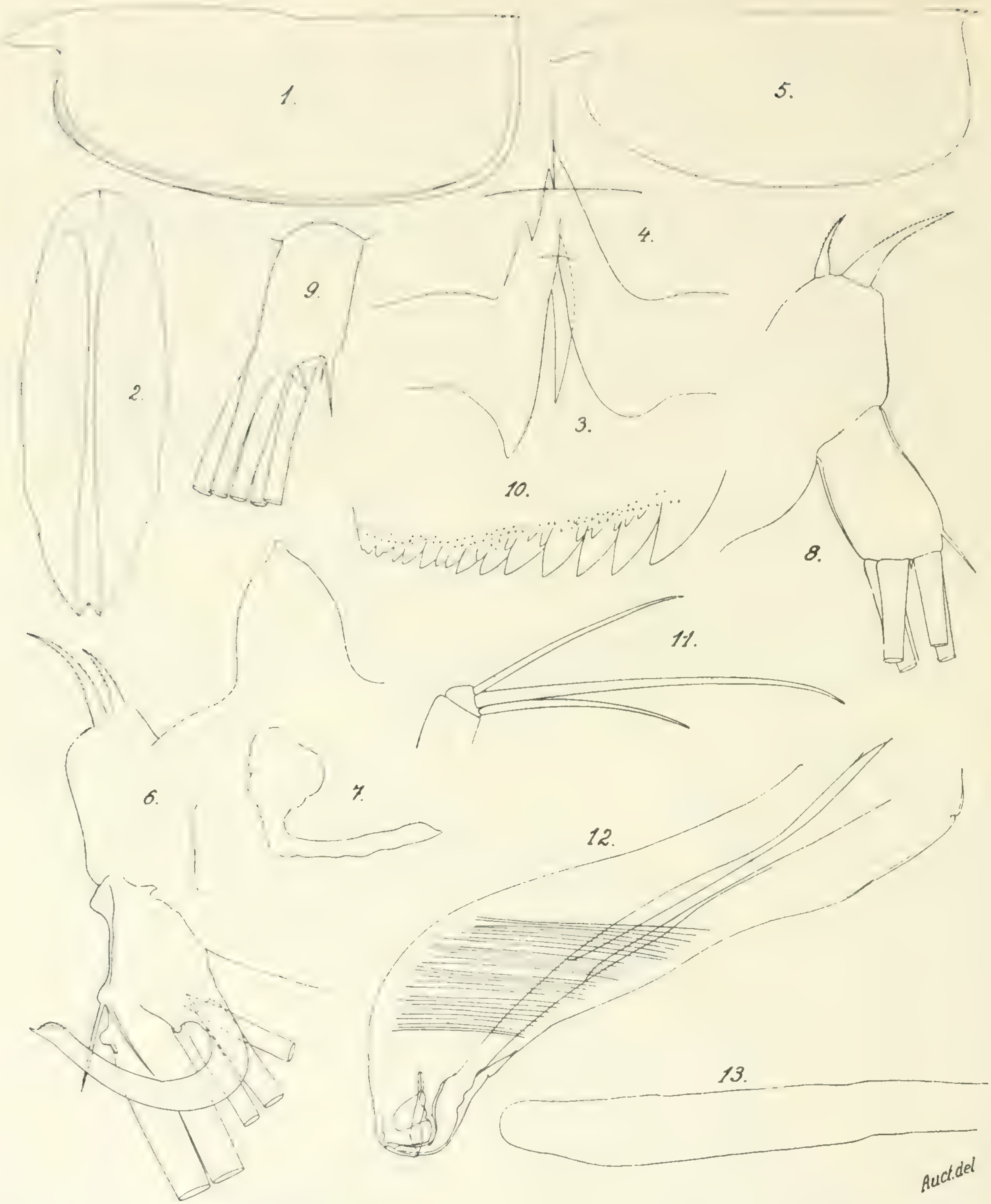

Fig. CXVII. — *Conchoecia elegans* G. O. Sars. — 1. Shell seen from the side, ♂; 40 ×. 2. Shell seen from below, ♂; 33 ×. 3. and 4. Postero-dorsal corner of the shell seen from inside, ♂; 400 ×. 5. Shell seen from the side, ♂ juv., stage I; 40 ×. 6. Endopodite of the right second antenna seen from inside, the long distal bristles are broken, ♂; 353 ×. 7. Clasping appendage of the endopodite of the left second antenna, ♂; 353 ×. 8. Endopodite of the left second antenna seen from inside, the distal bristles are broken, ♀; 400 ×. 9. Endopodite (distal joint) of the right second antenna seen from outside, the end bristles are broken, ♂ juv., stage I.; 400 ×. 10. Proximal tooth-list of the right mandible seen from inside, ♂; 1033 ×. 11. Distal part of the sixth limb, ♀; 187 ×. 12. Penis seen from outside; 260 ×. 13. Distal part of the rod-shaped organ, ♀; 450 ×. (Figs. 1—3, 6—8, 11, 12 are drawn from specimens from Lofoten; figs. 5, 9, 10, 13 from specimens from Koster and fig. 4 from a specimen from station 64 b.)

an almost symmetrical rostrum, posteriorly it is somewhat pointed. The shoulder vault is well developed, but is always rounded. To judge from the literature the surface sculpture varies: G. O. SARS writes, 1865, p. 117: „striis numerosis densissimis et decussatis reticulatae“; G. W. MÜLLER, 1901: „Bisweilen zeigt die Schale eine deutliche Streifung. Meist erkennt man als Rest einer Streifung nur eine Zähnelung resp. Felderung an der vorderen Hälfte des Ventralrandes, und auch diese kann fehlen“. Cf. also V. VÁVRA, 1906, p. 42. The specimens investigated by me showed an agreement with G. O. SARS's original description with regard to this character, but the reticulation was sometimes rather difficult to verify. The variation is perhaps only apparent; cf. G. W. MÜLLER, 1906 a, p. 33. The surface of the shell is without or practically without hairs. Seen from inside: Selvage: This is in most cases smooth-edged on the rostrum and has no spine-like process. It is quite smooth-edged or sometimes exceedingly finely serrulated along the anterior margin of the shell and the anterior half of the ventral margin of the shell; it is finely serrulated along the posterior half of the ventral margin of the shell and along the ventral half of the posterior margin of the shell. There are compound glands as described by G. W. MÜLLER, 1906 a. The glands along the posterior margin of the shell are moderately large and have their exits on the margin of the shell itself; only one or a few emerge (with a simple exit) between the list and the margin of the shell. There is no hinge-socket or hinge-tooth at the postero-dorsal corner of the shell.

First antenna: — The first joint is comparatively long and has in most cases a rather distinct contraction near the base; cf. the accompanying fig. 14; the proportion between the lengths of the first and second joints is about 8 : 5. The b-, d- and e-bristles are in most cases subequal and somewhat shorter than this limb. E-bristle: This bristle has at about two-thirds of the way along it an oval plate like a suctorial organ of about the type reproduced in fig. 15; the edge of this plate is — at least as far as I could observe — smooth. Just distally of this plate there is a somewhat varying number of short and rather powerful spines, arranged in two groups situated near each other; the number of spines is most frequently about the same as in the accompanying fig. 15. Just distally of these spines this bristle is in most cases bent at a distinct angle. The part of the bristle distally of these spines is closely and finely annulated or partly hyaline, bare, and is not at all or only slightly widened. (Note that the proportion between the sucker-like plate and the part of this bristle situated distally of this is quite incorrect in G. W. MÜLLER's work of 1901.) The part of this bristle situated proximally of the sucker-like plate is furnished on its anterior side with sparse and exceedingly short bristles (scarcely perceptible with REICHERT's ocul. 4, LEITZ's immersion $^1/_{12}$). B- and d-bristles: These seem sometimes to be quite bare, sometimes one or both of them has a rather small number of short, moderately strong or rather weak spines about opposite the sucker-like appendage of the e-bristle. The distal part of these bristles is of about the same type as that of the e-bristle; the bending into an angle is about the same as in the latter bristle or in most cases somewhat weaker. None of these three bristles has distinct pad-like formations; it is to be noted, however, that their distal parts have in certain positions a structure that reminds one rather strongly of such formations. The a-bristle is very long, in most cases about as long as or somewhat shorter than, sometimes even somewhat longer than the b-, d- and e-bristles; in most cases it is more or less straight,

pointing backward when in a position of rest; it is without any accessory saccules. The e-bristle is straight and rather short, about as long as the proximal height of the second joint. All the joints are quite bare. In the first joint there are often some yellowish-brown corpuscles.

Second antenna: — Protopodite: In specimens whose shells were about 2.2 mm. long this measured about 1.0—1.1 mm. Exopodite: The proportion between the length of this branch and that of the protopodite is about 1 : 2. The proportion between the length of the first joint and the total length of the eight following joints is about 2 : 1. The proportion between the length of the longest natatory bristles and that of the exopodite is about 7 : 4. The first joint, at least as far as I could observe with REICHERT's ocular 4 and LEITZ's immersion 1/12, is quite smooth. Endopodite (figs. 6 and 7): First joint: The processus mammillaris has in most cases a small verruciform distal process. The a- and b-bristles most frequently have short hairs at the middle and are bare distally. Second joint: The c- and d-bristles are in most cases somewhat shorter than this joint and have short, fine hairs or are almost quite bare. The e-bristle is extremely short. The f-bristle is about one and a half times the length of the protopodite, sometimes even somewhat longer; it grows gradually narrower distally and is bare. The g-bristle is, contrary to what is the case in most of the other species of this genus, shorter than the f-bristle; it attains only about a half or two-thirds of the latter's length; it is not at all or only slightly widened distally and is furnished in most cases with short hairs. The f- and g-bristles have no proximal swellings. Third joint: The clasping organs are of about the types reproduced by G. W. MÜLLER, 1906 a, pl. XIII, figs. 21 and 22. The h-, i- and j-bristles are subequal, about a third or a quarter of the length of the f-bristle; along the greater part of their length they are about as broad as the proximal part of the g-bristle; they are not widened proximally and have only rather slightly developed shafts; they are bare. There are sometimes some small yellow corpuscles in the protopodite and the endopodite.

Mandible: — Protopodite: Coxale: The toothed edge on the pars incisiva has from about ten to twelve teeth. The distal tooth-list is of about the same relative size and type as has been described for *C. oblonga* above; the number of teeth varies somewhat, from about twenty to thirty were observed. The proximal tooth-list is rather slightly narrower than the distal one; there are a somewhat varying number (about fourteen to twenty) of teeth, in most cases smooth and conical, arranged more or less distinctly in a simple row; the posterior ones of these are rather large and powerful, the others decrease either (as in the accompanying fig. 10) rather uniformly in size and strength the more anteriorly they are situated, the anterior ones being rather small and weak, or else this decrease in length and strength is rather irregular. This tooth-list is furnished on the inside with numerous short, fine spines, situated close together. The masticatory pad is of about the same relative size and type as has been described above for *C. oblonga*. The part of the pars incisiva that is surrounded by the row of bristles also shows signs of being developed as a masticatory pad. The lancet-bristles are, as C. CLAUS pointed out, 1891 a, p. 63 „zur Seite gedrängt, in dem dichten Borstensaum mehr oder minder versteckt". Basale: The six teeth on the distal edge of the endite are furnished with rather fine serrate teeth. The single tooth on the outside of this process is of about the same type and size as in my fig. 19 of *C. symmetrica*; in most cases it is moderately strongly serrulated along the greater

part of both its anterior and posterior edges; its point is always smooth. The epipodial appendage consists of a small verruciform process. Endopodite: The first joint has only two posterior bristles, both with short hairs; one of these, situated somewhat laterally, is rather long, in most cases about as long as the anterior sides of the first and second endopodite joints, the other, situated somewhat medially, is most frequently about a third shorter. The three anterior bristles of the second joint are comparatively long; the longest of them is about as long as the longest bristle on the end joint; their relative proportions are, however, about the usual ones in this genus.

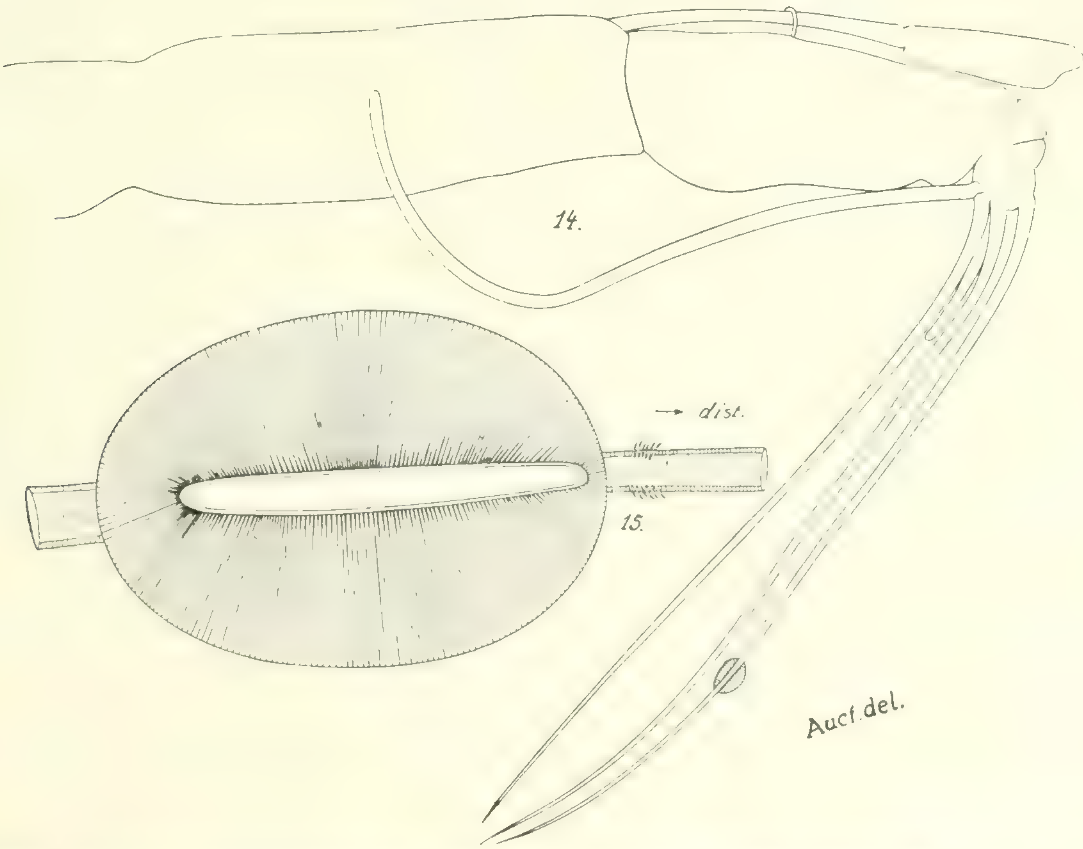

Fig. CXVIII. — *Conchoecia elegans* G. O. SARS, ♂. — 14. Right first antenna + the rod-shaped organ: 150 ×. 15. Suctorial organ of the e-bristle of this antenna: 938 ×.

Maxilla: — Endopodite: In the specimens investigated by me (both from the Arctic and the Antarctic) one of the three bristles on the posterior side of the first joint was always furnished at the middle with rather long, stiff secondary bristles. In one specimen I observed (as an abnormality) on the maxilla of one side two bristles situated close together (instead of one, as is otherwise the rule in this genus) somewhat distally of the middle on the inside of this joint. The ventral side of the end joint is about as long as the distal width of the preceding joint (calculating from front to back); its dorsal side is somewhat more than half this length. The end joint is often partly furnished with hairs.

F i f t h l i m b: — P r o t o p o d i t e: The longer of the two tube-bristles on the second endite always seems to be furnished with rather long and stiff secondary bristles at the middle. E n d o p o d i t e: Very like that of *C. oblonga*. In exceptional cases there were in the specimens investigated by me two, not one as is normal in this genus, tube-bristles dorsally of the short, dorsal claw; one of these two tube-bristles was rather short. E x o p o d i t e: First joint: This has two medio-ventral bristles, which are in most cases subequal and about as long as the proximal height of this joint, both with short hairs. The proximo-ventral group of bristles has three or four bristles in it; these vary somewhat in length, the longest often being about as long as the medio-ventral ones, the shortest about half as long; one of the longest of these bristles usually has long secondary bristles, the others usually have short hairs. The disto-ventral group of bristles usually contains two or three bristles, all usually with short hairs, the longest in most cases about as long as the medio-ventral bristles, the two others usually considerably shorter and weaker. The dorso-lateral bristle is most frequently somewhat shorter than in my fig. 27 of *C. symmetrica* and is furnished with long hairs; in one specimen I observed on one fifth limb two such bristles situated close together. End joint: The middle claw is in most cases somewhat longer relatively than in my fig. 27 of *C. symmetrica*; the dorsal bristle is about a third or a quarter shorter than the middle claw. Pilosity: The protopodite and the first exopodite joint are often furnished with sparse hairs.

S i x t h l i m b: — The two bristles of the e n d o p o d i t e most frequently have short hairs. E x o p o d i t e: First joint: The ventral bristles are in most cases relatively shorter than in my fig. 29 of *C. symmetrica*; most or all of them have short hairs. One of the most distal of these bristles is often absent. The dorso-lateral bristle of this joint usually has long secondary bristles.

P e n i s (fig. 12): — This is somewhat S-shaped; its distal part is bent ventrally. Somewhat distally of the middle it has from about four to six oblique transverse muscles, distally of which there are no muscles. It has a moderately large and distally rounded copulatory appendage.

F u r c a: — There is no unpaired bristle behind the claws.

R o d - s h a p e d o r g a n: — The capitulum, which points forward, reaches with its point to about the point of the first antenna and is about as long as the height of the second joint of this limb; its shape is about the same as in pl. XIII, fig. 20, G. W. MÜLLER, 1906 a; cf. the adjoining fig. 14.

U p p e r l i p: — The part between the combs on the postero-ventral edge of this lip is in most cases of about the type reproduced in my fig. 37 of *C. symmetrica*, but slight variation was found. The p a r a g n a t e s are of about the same type as in the species just mentioned.

F e m a l e: —

S h e l l: — Length: G. W. MÜLLER gives this (1906 a) as: 1,1—2,1 mm. „die großen Individuen über 1,9 . . . . stammen aus der Arktis" (the same author, 1912). The specimens investigated by me had the following lengths: Skager Rak and Cattegat: 2,0—2,15 mm.; Lofoten, 1,95—2,25 mm.; Arctic Ocean: 1,8—2,2 mm.; Atlantic Ocean: 1,15—1,6 mm.; Antarctic Ocean: 1,5—1,85 mm. The females from both the Arctic (with Skager Rak and Catte-

gat) and the Antarctic were on an average somewhat smaller than the males. The shape differs from that of the male especially by the posterior part of the shell being somewhat larger than the anterior part. The spine on the postero-dorsal corner of the right valve is more powerfully developed than in the male, about the same as in pl. XIII, fig. 19, G. W. MÜLLER, 1906 a; in the Antarctic females this process was as well developed as in the Arctic ones. In other respects the shell resembles that of the male.

First antenna: — The boundary between the first and second joints is weakly developed. On the anterior side of the proximal third of the e-bristle there are rather sparse short hairs. All the joints are bare. In the proximal part of this limb there are in most cases rather abundant small yellowish-brown corpuscles (explained as eyes by some previous writers; cf. p. 560 above).

Second antenna: — The protopodite is only slightly smaller than in the male. The proportion between the length of the protopodite and that of the exopodite is about the same as in the male. Endopodite: This has two joints, the original second and third joints being quite united. One of the c- and d-bristles is sometimes developed and is in most cases somewhat shorter than the width of the second joint; it is bare or almost bare; cf. my fig. 8; in most cases, however, both these bristles are absent. The g-bristle is about a quarter or a third shorter than the protopodite, sometimes even still shorter; it is only slightly sword-shaped distally and is furnished with sparse and extremely short and fine hairs. The f-, h-, i- and j-bristles are of somewhat different lengths, about a quarter or a third shorter than the g-bristle; they are bare. It is to be noted that in this sex the g-bristle is thus longer than the f-bristle, contrary to what is the case in the males. The h-, i- and j-bristles have no distinct shafts. Between the h- and i-bristles there is a short peg-like process. Pilosity: The second endopodite joint is bare.

Sixth limb: — The long-haired bristles of the endopodite and the first exopodite joint are often somewhat shorter in comparison and more weakly developed than in my fig. 30 of *C. symmetrica*. The dorsal one of the three bristles on the end joint is about a third shorter than the middle one; sometimes it is even still shorter; cf. the adjoining fig. 11.

Rod-shaped organ: — This varies somewhat in type; in most cases it is about the same as in the adjoining fig. 13; cf. also G. W. MÜLLER, 1906 a, pl. XIII, fig. 23. The shaft reaches to about the boundary between the second and third joints of the first antenna. The capitulum, which points straight forward, is somewhat longer than in the male.

Remarks: — It seems to be quite certain that the form dealt with by me above is identical with *C. elegans*, G. O. SARS, 1865. The original description of this species is certainly very incomplete and, if the material were caught in a region so rich in similar forms as, for instance, the middle Atlantic, it would not have been adequate for a quite certain identification of the species. The region in which G. O. SARS caught the species in question — the coast of Norway — is, however, very poor in Halocyprid species. Although the plankton fauna of this region has been subjected to a rather intensive study, it has so far been found to comprise only three species of this group, namely *Conchoecia elegans*, *C. obtusata* and *C. borealis*, which were all established *Synonyms.*

at the same time by the author just mentioned; as far as I can see these three are also the only species of this group that are found in this region (at least regularly and in any great number (G. O. SARS writes of the occurrence of *C. elegans* „haud frequens in freto Drøbakiensi . . .; copiosissime vero ad insulas Lofotenses"). These three species are of such well differentiated types that the descriptions worked out by the author mentioned are quite sufficient to distinguish them. It is also to be noted that the description and figures given above are based partly on material from one of the original localities — Lofoten — which was determined by G. O. SARS himself for *C. elegans*, and partly on material from Koster, a locality situated rather near Drøbak, one of the two other original localities.

It is true that another species of the genus *Conchoecia* has been described from about the same region, namely *C. quadrangularis* C. W. S. AURIVILLIUS (from the west coast of Sweden), but this species is, as G. W. MÜLLER has already pointed out, 1901, p. 3, certainly a synonym of *C. elegans*. It is true that I have not been able to verify the correctness of this identification by a re-examination of the original material, as this, as far as I could discover, has been lost, but owing to the poverty of this region in Halocyprid species, a fact that has already been pointed out above, it is nevertheless very easy to decide this problem with full certainty. An investigation of samples of plankton from the same localities and taken at the same time of the year as AURIVILLIUS's original material was captured showed that *C. quadrangularis* certainly corresponds to larvae of *C. elegans*. It seems difficult to decide which larval stage or stages the author in question was dealing with; presumably it was Stages I and II, but this question is, of course, of minor importance. A detailed discussion as to which characters in *C. quadrangularis* show the larval type and which characters decidedly indicate identity with *C. elegans* would be superfluous.

The identification of *Paraconchoecia gracilis*, C. CLAUS, 1890 and 1891 a with *C. elegans* also seems to be quite certain. This identification was first made by G. S. BRADY and A. M. NORMAN, 1896. Curiously enough, in spite of this, G. S. BRADY adopts the name *Paraconchoecia gracilis* in his later works, 1902 a and 1907.

Most of the names taken up in the list of synonyms given above have no verifying statements and drawings; these names are: *Conchoecia elegans*, G. O. SARS, 1869; E. VANHÖFFEN 1897; O. NORDGAARD, 1898, 1899 and 1905; C. W. S. AURIVILLIUS, 1898 and 1899; P. T. CLEVE, 1900 and 1903; H. H. GRAN, 1902; TH. SCOTT, 1902 b, 1905 and 1912 a; P. T. CLEVE and O PETTERSSON, 1903; C. H. OSTENFELD, 1906; G. W. MÜLLER, 1906 b and 1908; A. K. LINKO, 1907; E. KOEFOED, 1907; C. H. OSTENFELD and C. WESENBERG-LUND, 1909; C. APSTEIN, 1911; E. JÖRGENSEN, 1912; K. STEPHENSEN, 1913 and *Paraconchoecia gracilis*, G. S. BRADY, 1902 a and 1907.

All these statements, except those of G. W. MÜLLER, G. S. BRADY, 1907 and TH. SCOTT, 1912 a refer to finds from our Scandinavian and Arctic waters. Their inclusion in the list of synonyms is due to the fact that in these regions — at least as far as we know — there is no species found with which confusion seems probable. I have been able myself to verify a couple of these statements by a re-examination of the original material; these were: C. W. S. AURIVILLIUS, 1899 (= P. T. CLEVE, 1900; cf. p. 635 below) and P. T. CLEVE, 1903

(= P. T. CLEVE and O. PETTERSSON, 1903; cf. p. 634 below). It seems to me exceedingly probable that G. W. MÜLLER's identifications are correct. On the other hand it is only with a certain amount of hesitation that G. S. BRADY, 1907 and TH. SCOTT, 1912 a, are included in this list.

All the other names included in the list of synonyms given above are accompanied by descriptions or verificatory figures. Most of these descriptions and figures are not, however, so detailed and certain that they exclude the possibility of a confusion having taken place between this species and *C. discophora* G. W. MÜLLER; a confusion of this kind even seems not improbable in the case of V. VAVRA, 1906. All the same it seemed to me as a preliminary best to include all these names as synonyms; none of the names about which it may turn out that the doubts were justified refer to finds from regions from which *C. elegans* is not known with full certainty; this of course makes a possible mistake comparatively insignificant.

Difference between Arctic and Antarctic specimens.

The only difference that I succeeded in finding between Scandinavian and Antarctic specimens of this species after a very careful comparative examination was that which is pointed out on p. 625 above with regard to the posterior dorsal corner of the right valve in male specimens. The difference seems to me too slight to justify us in establishing an Antarctic variety (as was previously done by G. W. MÜLLER for the two other Scandinavian Halocyprids, *Conchoecia obtusata* and *C. borealis*).

Proportion between the sexes.

The following facts may be pointed out with regard to the proportions between males and females: G. H. FOWLER, 1909, observed the following proportions:

	Mature specimens	Larvae in Stage I	Larvae in Stage II
♂	61	94	84
♀	123	88	106

G. O. SARS points out (1865, p. 118) that he found a far greater number of females than males. „Af de talrige Exemplarer af naervaerende Art, som jeg har indsamlet, var den langt overveiende Del Hunner.“ (Of the numerous specimens of the present species collected by me the vast majority were females.)

An investigation that I made of the Swedish Hydrographic Biological Commission's material from Skager Rak showed the following results:

12th August, 1901:

	Mature specimens, Sample I	Mature specimens, Sample II	Larvae in Stage I, Sample I	Larvae in Stage I, Sample II	Larvae in Stage II
♂	24	9	7	6	
♀	10	6	9	5	

1st—7th February, 1911:

	Mature specimens, Sample I	Mature specimens, Sample II	Mature specimens, Sample III	Mature specimens, Sample IV	Larvae in Stage I, Sample I	Larvae in Stage I, Sample III	Larvae in Stage I, Sample IV	Larvae in Stage II, Sample III	Larvae in Stage II, Sample IV
♂	12	33	5	11	19	33	56	16	39
♀	13	26	31	98	20	31	45	6	9

We thus see that the proportions between males and females in the samples investigated by me were very varied. In the first larval stage males and females were found in about the

same number both in the August sample and the February one. Thus in the August sample there were 13 ♂ and 14 ♀, in the February sample 108 ♂ and 96 ♀. This observation agrees very well with G. H. FOWLER's result. On the other hand there were in my samples a far greater number of males than females in the second larval stage. The explanation of this phenomenon certainly seems to be that the females of this stage, on account of their small size, passed through the meshes of the plankton net in far greater numbers than the males; it is to be noted that the still smaller larval stages were almost entirely absent in these samples; cf. G. H. FOWLER's result above. Males and females presumably occur during the larval period in about a proportion of 1 : 1. The proportion between the mature males and females seems to be subject to rather considerable variation. In the August sample the males predominate, in sample I even almost in the proportion of 2.5 : 1 and similarly in sample II of February; in sample I of the latter month both sexes are almost equally represented and in samples III and IV of this month the females are very strongly predominant. See also below.

Do the males die comparatively soon?

What is the cause of this variation? Do the males die comparatively soon after attaining maturity? The fact that the February samples are taken at about the same time and the same locality (cf. below) does not seem to indicate this. But no definite answer can be given to this question before renewed investigations have been carried out with more abundant material.

Habitat: — Skager Rak and Cattegat:

North Koster; 2. II.: Depth, 30 m.: very rare (only one specimen). Depth, 65 m.: very common; R. M. S. 331. South Koster; 1. II.: Depth, 0 m.: very rare (only one specimen); R. M. S. 332. Depth, 30 m.: very rare; R. M. S. 333. Depth, 65 m.: neither common nor rare; R. M. S. 334. Depth, 125 m.: very common. Depth, 140 m.: very common (= 316 specimens); R. M. S. 335. Väderöarna (off Fjällbacka); 6. II.: Depth, 0 m.: very rare; R. M. S. 336. Depth, 30 m.: very rare (only one specimen); R. M. S. 337. Depth, 65 m.: very common; R. M. S. 338. Hållö (N. of Lysekil); 7. II.: Depth, 30 m.: common; R. M. S. 339. Depth, 65 m.: rare; R. M. S. 340. Måseskär (S. of Lysekil); 8. II.: Depth, 30 m.: very rare; R. M. S. 341. Pater Noster (Marstrand); 8. II.: Depth, 0 m.: very rare (only one specimen); R. M. S. 342; Depth, 30 m.: very rare; R. M. S. 343. Vinga (Göteborg); 9. II.: Depth, 30 m.: very rare; R. M. S. 344. — All these samples were taken by the Swedish Hydrographical Biological Commission during a cruise in 1911.

South Koster; 12. VIII.; depth, 150—0 m.: 1 female; R. M. S. 369. Lat. 58° N., long 9° E. (= S. VIII); 9. VIII.: At the surface: 9 mature males, 6 mature females and 11 juvenes; R. M. S. 378. Depth, 300—0 m.: 24 mature males, 10 mature females and 16 juvenes; R. M. S. 379. Lat. 58° 20′ N., long. 10° 5′ E. (= S. VII.); 10. VIII.; depth, 150—0 m.: 4 mature males and 24 juvenes in different stages; R. M. S. 370. Lat. 58° 46′ N., long. 10° 25′ E. (= S. X.); depth, 40 m.; 9. VIII.: 3 mature males, 8 mature females and 6 juvenes; R. M. S. 380. (Partly = the material of P. T. CLEVE, 1903.)

Coast of Norway:

Lofoten Islands; coll. et determ. G. O. SARS; 17 mature males and 102 mature females.

A r c t i c O c e a n:

Lat. 79° 58′ N., long. 9° 35′ E.; depth, 400—0 m.; 27. VIII. 1898: 1 mature male and 6 mature females; R. M. S. 371. Lat. 78° 13′ N., long. 2° 58′ W.; depth, 2600—0 m.; 29.—30. VII. 1898: 1 mature female; R. M. S. 374. Lat. 77° 52′ N., long. 3° 5′ W.; depth, 500—0 m.; 29. VII. 1898: 1 mature male and 4 mature females; R. M. S. 373. Lat. 76° 36′ N., long. 12° 13′ E.; depth, 500—0 m.; 1. VIII. 1898: 1 mature female; R. M. S. 375. Lat. 74° 15′ N., long. 18° 15′ W.; depth, 280—0 m.; 5. VII. 1899: 1 mature male and 3 mature females; R. M. S. 377. Lat. 66° 53′ N., long. 2° 52′ W.; depth, 500—0 m.; 5. VI. 1899: 3 mature females and 2 juvenes; R. M. S. 372. Lat. 66° 52′ N., long. 2° 55′ W.; depth, 500—0 m.; 4. IX. 1899: 1 mature male and 1 mature female; R. M. S. 376. — All these samples were taken during a Swedish Arctic Expedition 1898—1899 (— C. W. S. AURIVILLIUS, 1899, pp. 37, 58, 62, 66 and P. T. CLEVE, 1900, p. 39).

A t l a n t i c O c e a n:

S. A. E., Pl. station 26, lat. 32° 21′ N., long. 19° 8′ W.; at the surface; 6. XI. 1901; temperature, 20°,5 C.: 1 mature female; R. M. S. 210. S. A. E., Pl. station 34, lat. 27° 49′ N., long 20° 51′ W.; at the surface; 8 XI. 1901; temperature, 21,°4 C.: 1 mature female; R. M. S. 211. S. A. E., Pl. station 45, lat. 22° 8′ N., long. 22° 52′ W.; at the surface; 11. XI. 1901; temperature 23,°3 C.: 1 mature female; R. M. S. 213. S. A. E., Pl. station 134, lat. 24′ 21′ S., long. 41° 23′ W.; at the surface; 6. XII. 1901; temperature, 23.°2 C.: 1 mature male, 1 mature female and 2 juvenes; R. M. S. 219.

A n t a r c t i c O c e a n:

S. A. E., Pl. station 34 b, lat. 46° 45′ S., long. 58° 2′ W.; depth, 700—500 m.; 28. XII. 1901; temperature unknown: 2 mature males, 4 mature females and 2 juvenes; R. M. S. 212. S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth, 2500—0 m.; 23. VI. 1902; temperature at the surface, 7,°90 C.: 20 mature males, 35 mature females and 8 juvenes; R. M. S. 217. S. A. E., Pl. station 66 b, at the same locality; depth, 200—0 m.; temperature at 200 m., 5,25° C.: 2 mature males and 2 juvenes; R. M. S. 218. S. A. E., Pl. station 347, lat. 49° 3′ S., long. 46° 54′ W.; at the surface; 25. VI. 1902; temperature 4.5° C.: 1 mature female. S. A. E., Pl. station 70 b, lat. 49° 56′ S., long. 49° 56′ W., depth 2700 to 0 m.; 27. VI. 1902; temperature at 2700 m. and at the surface, ÷ 1.67° C. and 3.40° C.: 7 mature males, 6 mature females and 8 juvenes; R. M. S. 216. At the same station; depth, 500—0 m.: 1 mature female and 14 juvenes in different stages; R. M. S. 215. S. A. E., Pl. station 59 b (and 318), lat. 53° 0′ S., long. 48° 27′ W.; depth, 500—0 m.; 17. IV. 1902; temperature at 500 m. and at the surface, ÷ 1°50 C. and 3.40° C. resp.: 3 mature males, 4 mature females and 2 juvenes; R. M. S. 214 and 221. S. A. E., Pl. station 317, at the same locality; depth 250—0 m.; 17. IV. 1902; temperature at 250 m., ÷ 1.30° C.: 1 juvenis; R. M. S. 220.

Distribution: — In the Atlantic from lat. 79° 58′ N. (C. W. S. AURIVILLIUS, 1899) to lat. 55° S. (G. W. MÜLLER, 1906 a) and the Indian Ocean. On the other hand I know of no information about this species occurring in the Pacific (cf. G. W. MÜLLER, 1912).

The new localities mentioned by me above are consequently within the region of distribution previously known. G. W. MÜLLER's statement (1908, p. 67) that this species never occurred in samples of the „Deutsche Süd-Polar-Expedition" from stations south of lat. 43° S. is noteworthy („auch der Fang unter 43° steht vereinzelt da"). This writer then adds: „danach scheint es sich bei dem Fang der „Valdivia" unter 55° S. Br., der auch ganz vereinzelt dasteht, um verschlagene Individuen zu handeln". The localities south of lat. 43° S. given by me above seems to show with all certainty that this assumption cannot be correct; cf. also the size of the specimens found by me in Antarctic waters with that of the Atlantic specimens.

Daphnoides group G. W. MÜLLER

(*Conchoecilla* C. CLAUS.)

This group, comprising, in addition to the species dealt with below, only two other species, is certainly quite a natural one.

Conchoecia Chuni G. W. MÜLLER.

Conchoecia Chuni, G. W. MÜLLER, 1906 a, p. 124; pl. XXXI, figs. 16—28.
,, ,, ,, ,, ,, 1908, p. 79.
,, ,, ,, ,, ,, 1912, p. 93.

Description: — See G. W. MÜLLER, 1906 a, p. 124.

Supplementary description: — Male: —

Shell: — Length: According to G. W. MÜLLER, 1,4—1,55 mm. The specimen investigated by me was 1.5 mm. long. Seen from the side it is of the type described and reproduced by G. W. MÜLLER. The posterior dorsal corner differs only very slightly in the right and left valves; in the right one it is furnished with an exceedingly small point; just in front of this corner the right valve is armed with one or two more or less powerful spines; see the accompanying fig. 1. The rostrum is symmetrical and of about the same type as is shown in pl. XXXI, fig. 19, G. W. MÜLLER, 1906 a. The shoulder vault is moderately developed and well rounded. The surface of the shell is bare. The sculpture and glands have been described by G. W. MÜLLER. Seen from inside: The selvage is smooth-edged except along the posterior part of the ventral margin of the shell, where it is exceedingly finely serrulated. There is no hinge-socket or hinge-tooth at the posterior dorsal corner.

First antenna: — This is of the type described and reproduced by G. W. MÜLLER. E-bristle: Proximally on the anterior side this is bare or almost bare (a few exceedingly short and fine hairs may perhaps be discovered with very great magnification); it is

not widened distally of the rows of spines. The b- and d-bristles are also narrow distally, are only furnished with a few short and fine secondary bristles at three-quarters of the way along them and have no pad-like appendages. All the joints are bare.

Second antenna: — Protopodite: The length in the specimen investigated by me was 0.7 mm. Exopodite: The proportion between the length of this branch and that of the protopodite was about 10 : 6. The proportion between the first joint and the total length of the eight following joints was about 10 : 4. The proportion between the length of the longest natatory bristles and that of the exopodite was about 22—25 : 15. The first joint is almost bare. Endopodite: First joint: The processus mammillaris is rather low and has no distal papilla. The a- and b-bristles have some few short secondary bristles, they are almost bare. Second

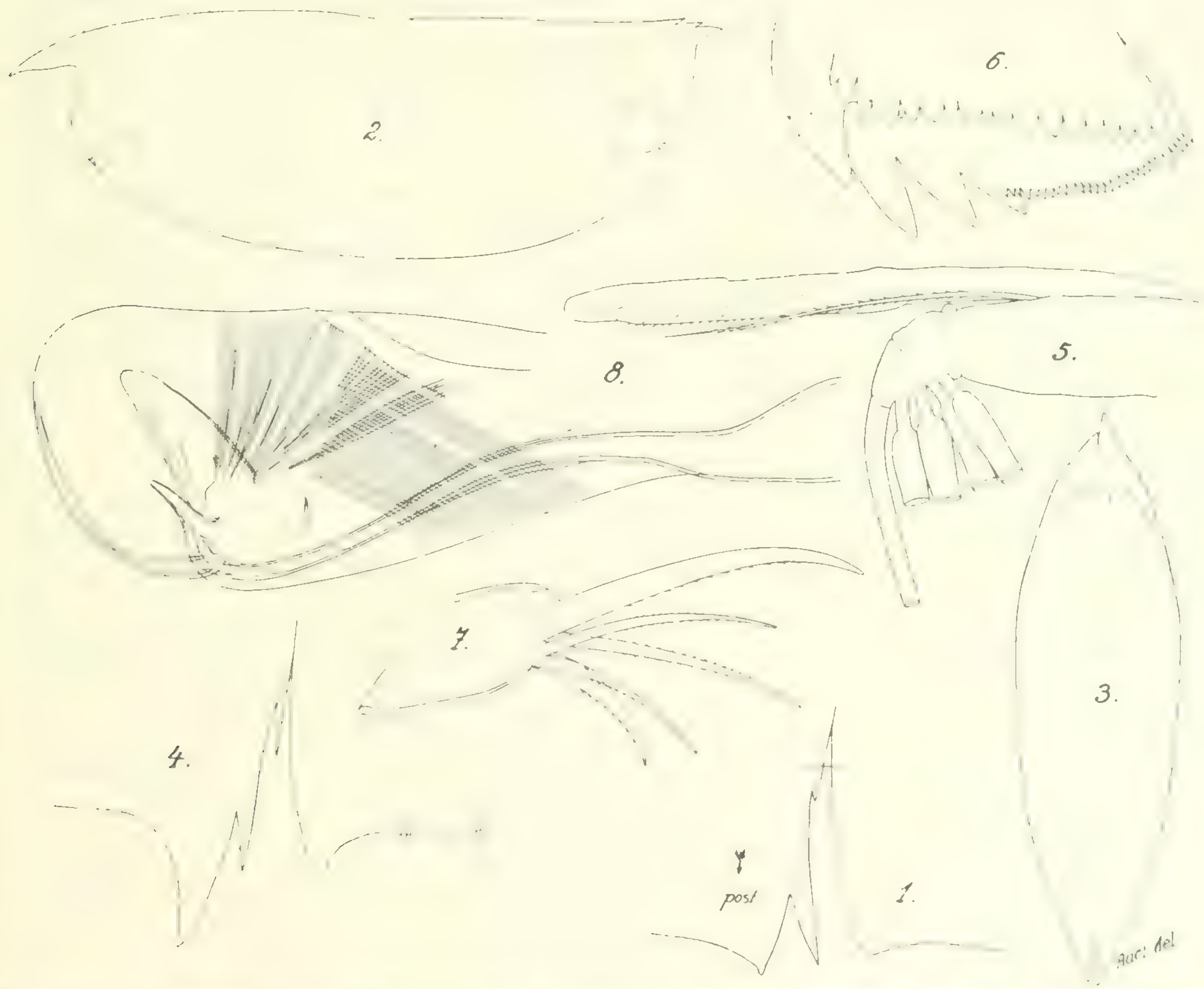

Fig. CXIX. *Conchoecia Chuni* G. W. Muller. 1. Posterior part of the shell seen from inside, ♂; 400 ×. 2. Shell seen from the side, ♀; 42 ×. 3. Shell seen from below, ♀; 34 ×. 4. Posterior part of the shell seen from inside, ♀; 233 ×. 5. Distal part of the rod-shaped organ and the left first antenna, the distal bristles are broken, ♀; 260 ×. 6. The tooth-lists on the right mandible seen from outside, ♂; 1200 ×. 7. End joint of the maxilla, ♀; 457 ×. 8. Penis seen from outside; 260 ×. (Fig. 4 is drawn from a specimen from station 64 b, all the others are from specimens from station 58 b.)

joint: The c- and d-bristles are rather slightly shorter than this joint; they have short hairs or are almost bare. The e-bristle is short. The g-bristle is somewhat shorter than the protopodite, the f-bristle is about a quarter or a fifth shorter than the g-bristle; both these bristles are narrow distally and have sparse, short hairs. Third joint: The clasping organs are of the types reproduced by G. W. MÜLLER, cross-striated distally (in the specimen investigated by me, however, they had no distal papilla as in the figures given by this writer). The h-, i- and j-bristles are subequal, somewhat less than half the length of the g-bristle and somewhat narrower than the f-bristle; they all have faint indications of shafts and are almost quite bare.

Mandible: — Protopodite: Coxale: The toothed edge on the pars incisiva has about ten to twelve teeth, the posterior ones are, however, so small that their number is difficult to decide. Distal tooth-list (fig. 6): This is of about the same relative size and type as has been described above for *C. oblonga*; sometimes, however, it has only one large posterior tooth; the number of teeth varies from fourteen to twenty. Proximal tooth-list: This is about as wide as the distal one. It has three or four powerful, conical, smooth posterior teeth and in front of these a dense row of rather fine serrate teeth; see the accompanying fig. 6. In other respects this joint is of about the same type as has been described below for *C. symmetrica*. Basale: The six teeth on the distal edge of the endite are finely serrulated. The single tooth on the outside of this endite is of about the same relative size and type as in *C. elegans*. The epipodial appendage consists of a small verruca and a very short bristle. Endopodite: The first joint has four posterior bristles, which have about the same positions and lengths as in *C. symmetrica* and have short hairs.

Maxilla: — The bristle on the basale, like most bristles on the anterior and posterior edges of the first endopodite joint, has a larger or smaller number of rather long secondary bristles. The end joint is relatively short; see the accompanying fig. 7.

Fifth limb: — This is of about the same type as in *C. symmetrica*, but the longer of the two tube-bristles on the second endite of the protopodite has short hairs and the endopodite has no spines. The two shorter of the three antero-ventral bristles on the endopodite are sometimes furnished with short hairs or sometimes one or both of them have rather long secondary bristles. First exopodite joint: From one to three of the four or five proximo-ventral bristles are sometimes furnished with rather long secondary bristles; sometimes they all have short hairs. One of the three or four ventero-distal bristles is sometimes furnished with rather long secondary bristles, sometimes they all have short hairs. The protopodite and the first exopodite joint are partly furnished with rather long hairs.

Sixth limb: — The bristles of the endopodite have short hairs. Exopodite: First joint: One of the anterior ones of the five ventral bristles is of about the same type and relative length as the corresponding bristle in my fig. 29 of *C. symmetrica*, the others are relatively short and have short hairs.

Penis: — This is of about the same type as is reproduced by G. W. MÜLLER; see the accompanying fig. 8. It has four oblique transverse muscles at the middle. Distally of these there is a collection of powerful muscles which have one end attached to the base of the copulatory appendage, from which point they radiate out like a fan towards the antero-dorsal side of the organ.

F u r c a: — This seems to have no unpaired bristle behind the claws.

R o d - s h a p e d o r g a n: — The shaft reaches to about the distal boundary of the second joint of the first antenna. The capitulum is somewhat shorter than the joint just mentioned; its type in the specimen investigated by me was about intermediate between pl. XXXI, figs. 24 and 25, G. W. MÜLLER, 1906 a.

The u p p e r l i p and p a r a g n a t e s are about the same as in *C. symmetrica.*

F e m a l e: —

S h e l l: — Length: According to G. W. MÜLLER, 2,0—2,4 mm. The specimens investigated by me measured 2,0—2,45 mm. Length : height is about 3 : 1; length : breadth about 3,4 : 1. S e e n f r o m t h e s i d e (see the accompanying fig. 2) it is of about the type described and reproduced by G. W. MÜLLER. S e e n f r o m b e n e a t h it has its greatest width at about the middle and the anterior part not at all or only slightly larger than the posterior part; the side contours are rather evenly curved, the anterior and posterior ends are pointed, the rostrum is unsymmetrical and not inconsiderably larger on the left valve than on the right; cf. the accompanying fig. 3. Both the right and the left valve are drawn out posteriorly into a not inconsiderable point, the one on the right valve being in most cases considerably more powerful than the one on the left (G. W. MÜLLER states the contrary). Just in front of this point there are sometimes on the right valve (as in the male) one or two more or less powerfully developed spines; see the accompanying fig. 4; sometimes there are no such spines at all. (G. W. MÜLLER does not mention these spines.) The glands are the same as are described by G. W. MÜLLER. In other respects this organ is like that of the male.

F i r s t a n t e n n a: — The first joint is about one and a half times the length of the second joint and shows signs of being divided into two joints. The joint division is otherwise very slight. The bristle on the second joint has short hairs and is somewhat longer than the capitulum of the rod-shaped organ (see fig. 5). E-bristle: This is about one and a half times as long as this limb or somewhat shorter; proximally on its anterior side it is furnished with sparse short secondary bristles. The a-, b-, c- and d-bristles are subequal, not inconsiderably less than half the length of the e-bristle. All the joints are bare. There are small yellowish-brown corpuscles in the second joint.

S e c o n d a n t e n n a: — P r o t o p o d i t e: In specimens 2,3 mm. long this measured 0,8 mm. The e x o p o d i t e is about the same as in the male. E n d o p o d i t e: This has three joints; the third joint is more or less well defined. The a- and b-bristles are like those of the male. There are no c-, d- and e-bristles. The f-bristle is somewhat shorter relatively than in the male, but in other respects the end-bristles on this branch agree fairly well in both sexes. There is a small papilla between the h- and i-bristles. The second endopodite joint is bare.

S i x t h l i m b: — First e x o p o d i t e joint: The dorso-distal bristle is very short. The dorso-lateral bristle on this joint is also somewhat shorter relatively than in my fig. 30 of *C. symmetrica.* The dorsal bristle of the end joint is sometimes even somewhat longer than the middle claw.

R o d - s h a p e d o r g a n: — The shaft is about the same as in the male. The capitulum is of about the same type as in *C. elegans* ; see the accompanying fig. 5; for this character compare, however, G. W. MÜLLER as well.

Habitat: — A n t a r c t i c O c e a n:

S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth 2500—0 m.; 23. VI. 1902; 2 mature females; R. M. S. 325. S. A. E., Pl. station 70 b, lat. 49° 56′ S., long. 49° 56′ W.; depth 2700—0 m.; 27. VI. 1902; temperature at 2700 m. and at the surface, + 1.67° C. and 3.4° C. resp.: 1 mature female; R. M. S. 326. S. A. E., Pl. station 58 b, lat. 53° 0′ S., long. 48° 27′ W.; depth 250—0 m.; 17. IV. 1902; temperature at 250 m. and at the surface, + 1.30° C. and 3.40° C. resp.: 1 mature male and 4 mature females; R. M. S. 324. S. A. E., Pl. station 312, lat. 53° 1′ S., long. 51° 53′ W.; depth 200—0 m.; 15. IV. 1902; temperature at 200 m. and at the surface 3.50° C. and 5,48° C. resp.: 1 mature female; R. M. S. 327.

Distribution: — South Atlantic Ocean between lat. 26° S. and lat. 43° S. Indian Ocean as far north as lat. 2° S.

All the finds of the „A n t a r c t i c" expedition were consequently made south of the area of distribution stated by G. W. MÜLLER.

Obtusata group G. W. MÜLLER.

G. W. MÜLLER puts only two species in this group, namely the species dealt with below, after which the group was called, and *C. parthenoda* G. W. MÜLLER. The latter species, of which only females are known, is included in this group only with the greatest hesitation. It is quite impossible to decide whether these two species are connected on account of the incomplete description of *C. parthenoda.*

Conchoecia obtusata G. O. SARS.

Conchoecia obtusata, G. O. SARS, 1865, p. 118.
Halocypris ,, ,, ,, ,, 1890, pp. 15, 53.
Conchoecia ,, G. S. BRADY and A. M. NORMAN, 1896, p. 693; pl. LXIII, figs. 1, 2.
,, ,, E. VANHÖFFEN, 1897, p. 285.
,, ,, O. NORDGAARD, 1899, p. 26.
,, ,, G. W. MÜLLER, 1901, p. 5; figs. 8—10.
,, ,, P. T. CLEVE, 1903, pp. 19, 24.
,, ,, P. T. CLEVE and O. PETTERSSON, 1903, pp. 2, 7.
,, ,, TH. SCOTT, 1905, p. 228.

Conchoecia obtusata, C. H. OSTENFELD, 1906, p. 96.
.. .. V. VÁVRA, 1906, p. 36; pl. I, figs. 13—19.
.. .. E. KOEFOED, 1907, pp. 150, 151, 156, 202.
.. .. C. H. OSTENFELD and C. WESENBERG-LUND, 1909, p. 113.
.. .. C. APSTEIN, 1911, p. 166; pl. XXIII.
.. .. E. JÖRGENSEN, 1912, pp. 14, 16.
.. .. G. W. MÜLLER, 1912, p. 74.
.. .. K. STEPHENSEN, 1913, p. 354.

Description: — See G. W. MÜLLER, 1901, p. 5, figs. 8—10 and V. VÁVRA, 1906, p. 36; pl. I, figs. 13—19.

Supplementary description. — Male:

Shell: — Length: According to G. W. MÜLLER, 1901 and 1912, 1,1—1,2 mm.; according to V. VÁVRA, 1,2 mm. The specimens investigated by me measured 1,15—1,35 mm. Length : height about 2 : 1; length : breadth about 2,5 : 1. Seen from the side it is of about the type reproduced by G. W. MÜLLER, 1901, fig. 8; in most cases, however, it has a straighter dorsal margin and the anterior part of the shell dominates somewhat less over the posterior part; cf. the accompanying fig. 1. Seen from below (fig. 3) it has its greatest width at or in most cases somewhat behind the middle. Its side contours are either rather evenly curved or else they are somewhat flattened at the middle. The posterior part of the shell, which sometimes dominates at least to some extent, though only rather slightly, over the anterior part, is somewhat pointed, the anterior part is somewhat more rounded and has an almost symmetrical rostrum. The shoulder vault is moderately well developed and well rounded. The surface of the shell is almost or quite bare. Sculpture: There is a weak concentric striation, in most cases rather difficult to observe. Seen from inside: Selvage: On the rostrum it either has an even edge or else it is irregularly serrulated. Along the anterior margin of the shell and the anterior part of the ventral margin it has in most cases an exceedingly fine serrulation; along the posterior part of the ventral margin it has a fine serrulation; the serrulation within the posterior margin of the shell is most frequently rather sparse. The part on the rostrum has no long bristle-like process. The unsymmetrical glands have their exits at the usual place. There are no lateral corner glands. Ventrally of the incisur there emerge some glands, which are small or large according to the physiological condition; cf. V. VÁVRA, 1906, pl. I, fig. 12. The medial glands along the posterior margin of the shell are moderately large; their exits are always simple, arranged in a rather distinct row running a short distance inside the margin of the shell and not joined by any distinct list. The junction between the lamellae is rather wide at the rostral incisur; dorsally of the incisur the lamellae are joined at a rather large rounded part; cf. the accompanying fig. 1. At the posterior dorsal corner of the shell there is a rather well developed hinge-socket and hinge-tooth of an oblong oval shape.

First antenna: — The b-, d- and e-bristles are either subequal or else the e-bristle is somewhat longer than the two others; they are about one and a third or one and a half times

Fig. CXX. — *Conchoecia obtusata* G. O. Sars. — 1. Shell seen from the side, ♂; 70 ×. 2. Shell seen from the side, ♀; 52 ×. 3. Shell seen from below, ♂; 55 ×. 4. The selvage on the rostrum, ♀; 833 ×. 5. Equipment of the e-bristle of the first antenna, ♂; 513 ×. 6. Distal part of the left first antenna and the rod-shaped organ; the b-, d- and e-bristles of the antenna are broken, ♂; 353 ×. 7. Distal part of the rod-shaped organ and the first antenna, ♂; 400 ×. 8. Distal part of the right first antenna and the rod-shaped organ, ♀; 353 ×. 9. Endopodite of the right second antenna seen from inside, the distal bristles are broken, ♂; 353 ×. 10. Distal part of the endopodite of the left second antenna seen from inside, the distal bristles are broken, ♂; 353 ×. (All these figures are drawn from specimens from Skager Rak.)

as long as this limb. E-bristle: Somewhat distally of the middle this bristle has, along about a quarter of its length, two rows of moderately strong spines pointing proximally, about fifteen to twenty in each row. All the spines are pointed and rather narrow, moderately long, the distal ones are somewhat shorter than the proximal ones; cf. the accompanying fig. 5. The distal spines in the two rows are arranged in pairs, but even at the fourth or sixth spine, counting distally-proximally, a tendency to alternation can be observed; from about the ninth or tenth spine all the spines are situated alternately. The two rows are well separated distally and approach each other more and more proximally until they form almost a single row. Distally of these rows of spines this bristle is quite bare, i. e. it has no more or less distally pointing spines such as we find, for instance, in my fig. 15 of *C. elegans*; cf. V. VÁVRA, 1906, pl. I, fig. 17. Just distally of these rows of spines this bristle is bent into a distinct angle; the part distally of this knee is not sword-shaped, but narrow. On the part proximally of the rows of spines there are on the anterior side of this bristle sparse short secondary bristles. The b- and d-bristles are not or are only slightly bent at an angle and are not widened distally. The b-bristle is furnished with a slight pad about opposite the spines of the e-bristle; distally of this pad there are in most cases some short, distally pointing, fine secondary bristles. The d-bristle has no pad but is furnished at about the corresponding place with secondary bristles that are about similar to those on the b-bristle. The a- and c-bristles are most frequently subequal or else the former is rather slightly longer than the latter; they are about as long as or somewhat shorter than the second joint. Neither of them has accessory saccules. The c-bristle is in most cases straight, the a-bristle more or less bent, but not rolled up like a spiral; cf. the accompanying fig. 6. All the joints are quite bare.

S e c o n d a n t e n n a: — P r o t o p o d i t e: In specimens with shells about 1,2 mm. long this was about 0,5 mm. long. The distal medial verruca is in most cases irregularly lobate in shape. E x o p o d i t e: The proportion between the length of this branch and the length of the protopodite is about 10 : 16 or 10 : 17. The proportion between the length of the first joint and the total length of the eight following joints is about 8 : 3 or 9 : 4. The proportion between the length of the longest natatory bristles and the length of this branch is about 5 : 3 or 4 : 3. As far as I could discover with REICHERT's ocular 4, LEITZ's immersion $^1/_{12}$, the first joint is quite bare. E n d o p o d i t e (see the accompanying figs. 9 and 10): First joint: The processus mammillaris is comparatively small and has no distal verruca. The a-bristle is furnished with short, fine hairs. The b-bristle, which also has short, fine hairs along the greater part of its length, has some (from about five to twelve) moderately long, stiff secondary bristles proximally of the middle. Second joint: The c- and d-bristles are of somewhat different lengths; the longest is not quite as long as this joint; they both have short, fine hairs or are almost bare. The e-bristle is exceedingly short. The g- and f-bristles are comparatively short and narrow; the proportion between the length of the g-bristle and that of the protopodite is about 4 : 5 or 3,5 : 5. The f-bristle is about a fifth or a quarter shorter than the g-bristle. The g-bristle has short, fine hairs, the f-bristle is bare. On the right antenna these two bristles are furnished with shafts of the type described by G. W. MÜLLER, 1901; on the left antenna there are only traces of a structure of this sort. Third joint: The clasping organs are of the types described

and reproduced by G. W. MÜLLER, 1901; on both the right and left antennae there are cross ridges distally; the right clasping organ may or may not have a few small chitinous verrucae on its proximal shank. The h-, i- and j-bristles are subequal and in most cases somewhat, though only slightly, shorter than the f-bristle; they are of about the same width as the f- and g-bristles distally of their shafts and are bare; none of them has any traces of a shaft.

M a n d i b l e: — P r o t o p o d i t e: Coxale: The toothed edge on the pars incisiva has from about nine to eleven teeth, of which the posterior ones are in a number of cases somewhat more developed than in my fig. 16 of *C. symmetrica*. The distal tooth-list is of about the same relative size and type as has been described for *C. oblonga* above. The proximal tooth-list is of about the same relative size and type as is described below for *C. spinirostris*, but the teeth seem to be on an average somewhat, though only rather slightly, fewer. The part situated proximally of this tooth-list is also of about the same type as in the last-mentioned species. Basale: The six teeth on the distal edge of the endite are furnished with rather fine serrate teeth. The single tooth on the outside of this endite is of about the same type and size as in my fig. 19 of *C. symmetrica*; in most cases it is finely serrulated along the greater of both the posterior and the anterior edge; its point seems, however, to be smooth in most cases. The disto-medial bristle of this joint is in most cases somewhat longer than in most species of this genus. There is no e p i p o d i a l a p p e n d a g e. E n d o p o d i t e: The first joint has only two posterior bristles, which have about the same position and relative length as in *C. spinirostris*.

Fig. CXXXI. [illegible] G. O. SARS. ♂. — 11. Penis, seen from outside (drawn as if it were semi-transparent); 260 ×. 12. The point of this organ seen from outside; 833 ×. (From a specimen from Skager Rak.)

M a x i l l a: — This is of the same type as is described below for *C. spinirostris*.

F i f t h l i m b: — This is of about the type described on p. 630 above for *C. elegans*, but in the specimens investigated by me there was never more than one tube-bristle dorsally of the short dorsal claw on the endopodite; in addition the shorter bristles in the ventero-distal group on the first exopodite joint were usually somewhat longer relatively than in the species just mentioned.

P e n i s (see fig. 11): — This is very powerful, relatively high and distally rounded. It has from about eight to thirteen transverse muscles in the distal half; distally of these there

are no muscles. The point has a complicated chitinous skeleton, but has no copulatory appendage; cf. the accompanying fig. 12.

F u r c a: — Behind the claws there is an unpaired short-haired bristle of about the same relative length as in fig. 33 of *C. symmetrica.*

R o d - s h a p e d o r g a n: — The shaft reaches to about the distal boundary of the second joint of the first antenna or somewhat farther. The capitulum is somewhat longer than the proximal height of the second joint of the first antenna and varies somewhat in type; sometimes it is of about the type shown in pl. I, fig. 15, V. VÁVRA, 1906, sometimes somewhat more bent upward; cf. the accompanying figs. 6 and 7.

U p p e r l i p: — The part between the combs on the posterior ventral edge of the lip is of about the type reproduced in my fig. 37 of *C. symmetrica* or else the median notch is somewhat deeper. The p a r a g n a t e s are of about the same type as in the species just mentioned.

F e m a l e: —

S h e l l: — Length: According to G. O. SARS, 1865, „circiter 2 mm.“; G. W. MÜLLER, 1901: 1,55—2 mm.; the same writer, 1912: 1,55—1,8 mm.; V. VÁVRA, 1906: „durchweg 1,9 mm.“. The specimens investigated by me measured 1,6—1,85 mm. S e e n f r o m t h e s i d e (cf. the accompanying fig. 2) it is of about the same type as the male shell, but the posterior part of the shell is somewhat more developed. S e e n f r o m b e l o w, too, the shell agrees fairly well in both sexes; the same variation with regard to the side contours is to be noted; we must note, however, that the posterior part of the shell in most cases dominates somewhat more over the anterior part in the female than in the male. S e e n f r o m i n s i d e: The selvage has a rather large spine-like process on the rostrum; see the accompanying fig. 4. In other respects the shell resembles that of the male.

F i r s t a n t e n n a: (fig. 8): — The dorsal bristle on the second joint is almost as long as the distal sensorial filaments and has short, fine hairs. The e-bristle is about twice the length of this antenna or somewhat longer and on the anterior side of its proximal quarter or third has sparse moderately long hairs. This bristle is not widened and sword-shaped distally. There are no pigment corpuscles in this limb. All the joints are bare.

S e c o n d a n t e n n a: — The p r o t o p o d i t e is almost as well developed as in the male. The proportion between the length of the protopodite and that of the e x o p o d i t e is also about the same as in the male. E n d o p o d i t e: This has two joints; I was unable to discover any boundary between the original second and third joints. First joint: Both the a- and b-bristles have short hairs. Second joint: The h-, i- and j-bristles are usually somewhat shorter than the f-bristle. The g- and f-bristles have no shafts. In other respects these five bristles are about the same as in the male. Between the h- and i-bristles there is an extremely small process. Pilosity: The second endopodite joint is bare.

S i x t h l i m b: — The dorsal bristle on the end joint is in most cases about a third shorter than the middle one, sometimes even somewhat shorter.

T h e r o d - s h a p e d o r g a n is of about the type reproduced by V. VÁVRA; cf. the accompanying fig. 8.

Synonymy.

Remarks: — The species dealt with by me above is described from specimens caught off the west coast of Sweden. It seems to me practically certain that it is identical with *C. obtusata*, G. O. SARS, 1865. It is true that the original description of the latter species is very incomplete, but for much the same reasons as have been put forward on p. 631 above in the case of *C. elegans* it appears to be quite sufficient for certainty of identification.

This species was at first referred by G. O. SARS to the genus *Conchoecia*; in a later work by this writer, 1890, however, it was transferred to the genus *Halocypris*. This alteration, presumably made under the influence of a statement in the same direction by C. CLAUS, 1874 a, p. 178, and only explicable, of course, as being due to G. O. SARS's slight knowledge of the differences between these two genera, has quite correctly been set aside by other writers.

The following names included in the list of synonyms given above are without descriptions and verificatory figures: G. O. SARS, 1890; E. VANHÖFFEN, 1897; O. NORDGAARD, 1899; P. T. CLEVE, 1903; P. T. CLEVE and O. PETTERSSON, 1903; TH. SCOTT, 1905; C. H. OSTENFELD, 1906; E. KOEFOED, 1907; C. H. OSTENFELD and C. WESENBERG-LUND, 1909; C. APSTEIN, 1911; E. JØRGENSEN, 1912 and K. STEPHENSEN, 1913. They are included in the list in question in spite of this, because they all refer to finds from regions in which this species is known for certain to exist. I was able to verify one of these statements myself by a re-examination of the original material; this was that of P. T. CLEVE, 1903 (= P. T. CLEVE and O. PETTERSSON, 1903).

G. S. BRADY and A. M. NORMAN's description, 1896, is based on some specimens from the coast of Norway, determined by G. O. SARS.

G. W. MÜLLER's description, 1901, which is apparently based on the same specimens as formed the basis of E. VANHÖFFEN's information, 1897, may be said to be sufficient for certainty of identification.

It may also be considered as quite certain that this was the form dealt with by V. VÁVRA, 1906. Are we to refer the most southerly finds in this author's work to this species as well?

On the other hand it did not seem to me proper to include in the above list of synonyms *Conchoecia obtusata*, G. S. BRADY, 1868 b, p. 470 (= the same writer, 1868 a, p. 128). The figure, pl. XLI, fig. 9, with which this author illustrates this find shows an organism of so peculiar a type that it seems to me quite impossible to identify it (= Ostracod?). This uncertainty on the part of this writer has also prevented me from including *C. obtusata*, G. S. BRADY and D. ROBERTSON, 1872, p. 70 as a synonym either. Nor has *C. obtusata*, A. M. NORMAN, 1869, pp. 256, 257, 260 and 295 been included; with regard to this find, which is presumably the same as was the basis of G. S. BRADY's information, 1868 a and b, the first-mentioned writer says (p. 295): „A single imperfect *Conchoecia*, believed to belong to this species . . . ."

Differences between descriptions and those of previous authors.

It is true that there are a number of small differences to be noted between the descriptions of this species worked out by preceding writers and the information given by me above, but it does not seem to me necessary to discuss these in any detail. Most of them are presumably due to lack of accuracy on the part of the previous writers.

Proportion between males and females.

There is so far no information in the literature as to the proportion between males and females in this species. In the material from Skager Rak investigated by me the males were in most cases rather considerably fewer than the females. Thus in a sample from Koster there

were, as will be seen below, 14 males and 29 females. In another sample 125 individuals were investigated, of which 39 were males and 86 females. In some cases the proportion was one to four or even one to five or males were quite absent. The females predominated in number in the larvae as well.

Habitat: — Skager Rak and Cattegat:

North Koster; 2. II.: Depth, 0 m.: 1 mature male, 5 mature females and 1 juvenis; R. M. S. 345. Depth, 30 m.: 2 mature males and 6 mature females; R. M. S. 346. Depth, 65 m.: 8 mature females and 1 juvenis; R. M. S. 347. South Koster; 1. II.: Depth, 0 m.: 2 mature males and 2 mature females; R. M. S. 348. Depth, 30 m.: 14 mature males, 29 mature females and 3 larvae; R. M. S. 349. Depth, 65 m.: 13 mature females and 2 juvenes; R. M. S. 350. Depth, 125 m.: 1 mature female; R. M. S. 351. Depth, 140 m.: 7 mature males, 6 mature females and 4 juvenes; R. M. S. 352. Väderöarna (off Fjällbacka); 6. II.: depth, 65 m.: 1 mature male and 3 juvenes; R. M. S. 353 and 354. Hållö (N. of Lysekil); 7. II.: Depth, 30 m.: 1 mature male, 5 mature females and 3 juvenes; R. M. S. 355. Depth, 65 m.: 2 mature males; R. M. S. 356. — All these samples were taken by the Swedish Hydrographical Biological Commission during a cruise in 1911.

Lat. 58° N., long. 9° E. (= S. VIII.); 9. VIII.: Depth, 0 m.: 6 specimens; R. M. S. 364. Depth, 20 m.: 8 specimens; R. M. S. 365. Depth, 40 m.: 4 specimens; R. M. S. 366. Depth, 300—0 m.: 23 specimens; R. M. S. 367. Lat. 58° 12′ N., long. 10° 29′ N. (= S. III.); depth, 200—0 m.; 8. VIII.: 8 specimens; R. M. S. 360. Lat. 58° 20′ N., long. 10° 5′ E. (= S. VII); 10. VIII.: Depth, 0 m.: 21 specimens; R. M. S. 362. Depth, 150—0 m.: 362 specimens; R. M. S. 361 and 363 (partly = the material of P. T. CLEVE, 1903).

Distribution: — The northern part of the Atlantic Ocean, chiefly north of lat. 60°, and the Arctic Ocean.

The localities investigated by me were part of the previously known area of distribution.

Conchoecia obtusata G. O. SARS var. antarctica G. W. MÜLLER.

Conchoecia obtusata var. *antarctica*, G. W. MÜLLER, 1906 a, p. 77; pl. XVI, figs. 10—23.
" " " " " " " 1908, p. 69.
" " " " " " " 1912, p. 75.

Diagnosis: — See G. W. MÜLLER, 1906 a, p. 77.

Remarks: — Of the specimens investigated by me the males measured 1.2—1.37 mm., the females 1,3—1,75 mm. Both among the males and the females there were partly specimens whose shells agreed well in shape with the type drawn by G. W. MÜLLER, 1906 a and partly those that resembled more or less the types reproduced by me above for the Scandinavian form. *Shell.*

Seen from below both the males and the female shells differ from those of the type species by having the posterior part somewhat less developed; in most cases this was not, even in the females, perceptibly larger than the anterior part.

With regard to the mandible, maxilla, fifth, sixth and seventh limbs, furca, upper lip and paragnates the Scandinavian and the Antarctic forms of this species agree with each other. The e-bristle on the female first antenna has proximally on the anterior side similar hairs to those of the type species.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth 2500 m. –0 m.; 23. VI. 1902; temperature at the surface 7,90° C.: 26 mature males, 65 mature females and 5 juvenes; R. M. S. 223 and 224. S. A. E., Pl. station 65 b, at the same locality; depth 400–0 m.; 23. VI. 1902; temperature at 400 m. + 3,95° C.: 2 mature males, 4 mature females and 1 juvenis; R. M. S. 225. S. A. E., Pl. station 66 b, at the same locality; depth 200–0 m.; 23. VI. 1902; temperature at 200 m., 5,25° C.: 1 mature female and 2 juvenes; R. M. S. 226. S. A. E., Pl. station 345, lat. 48° 32′ S., long 44° 28′ W.; at the surface; 24. VI. 1902; temperature 7,9° C.: 1 juvenis; R. M. S. 233. S. A. E., Pl. station 347, lat. 49° 3′ S., long. 46° 54′ W.; at the surface; 25. VI. 1902; temperature, 4,5° C.: 2 juvenes; R. M. S. 234. S. A. E., Pl. station 70 b, lat. 49° 56′ S., long. 49° 56′ W.; depth, 2700–0 m.; 27. VI. 1902; temperature at 2700 m. and at the surface, + 1,67° C. and 3,40° C. resp.: 5 mature females and 1 juvenis; R. M. S. 228. At the same station; depth 500–0 m.: 2 mature females; R. M. S. 227. S. A. E., Pl. station 302, lat. 52° 6′ S., long. 55° 32′ W.; depth, 500–0 m.; 12. IV. 1902; temperature at 500 m. and at the surface, 3,78° C. and 6,28° C. resp.: 2 mature males; R. M. S. 229. S. A. E., Pl. station 316, lat. 53° 0′ S., long. 48° 27′ W.; depth, 100–0 m.; 17. IV. 1902; temperature at 100 m. and at the surface, 3,0° C. and 3,40° C. resp.: 1 mature female; R. M. S. 231. S. A. E., Pl. station 317, at the same locality; depth 250–0 m.; 17. IV. 1902; temperature at 250 m., + 1,30° C.: 1 mature female; R. M. S. 232. S. A. E., Pl. station 312, lat. 53° 1′ S., long. 51° 53′ W.; depth 200—0 m.; 15. IV. 1902; temperature at 200 m. and at the surface, 3,50° C. and 5,48° C.: 1 mature male, 3 mature females and 2 juvenes; R. M. S. 230.

Distribution: — The Antarctic Ocean between lat. 26° S. and lat. 43° S. All the localities referred to above are thus south of the previously known area of distribution.

Rotundata group G. W. Müller.

This group comprises five species (one of which is divided into two sub-species) besides the two dealt with below. As has already been pointed out by G. W. Müller, it can be distinctly defined from other groups belonging to this genus. It is characterized especially by the position

of the unsymmetrical glands. The careful investigation of the two forms dealt with below that I carried out affords decided evidence that these two at least are very closely related to each other. Presumably the whole group is quite a natural one.

Conchoecia rotundata G. W. MÜLLER.

*Conchoecia rotundata**, G. W. MÜLLER, 1890 a, p. 275; pl. XXVIII, figs. 41—43; pl. XXIX, fig. 44.
.. .. 1906 a, p. 83; pl. XVII, figs. 23—34.
.. .. 1906 b, p. 4.
.. .. 1908, p. 69.
.. .. 1912, p. 77.
.. .. (part?), G. H. FOWLER, 1909, pp. 249, 273, 293; pl. XXIII and XXIV, figs. 205—224.

Description: — See G. W. MÜLLER, 1890 a, p. 275, 1906 a, p. 83 and G. H. FOWLER, loc. cit.

Supplementary description: — Male: —

Shell: — Length: According to G. W. MÜLLER, 1890a: 1,15 mm.; the same author writes on this point (1906 a): „♀ und ♂ 0,8—1,75 mm., die der Antarktis durchweg durch Größe (1,4—1,75 mm) vor denen der gemäßigten und warmen Zonen (0,8—1,4 mm) ausgezeichnet"; G. H. FOWLER, 0,75—1,0 mm. The specimens investigated by me measured 1,45—1,6 mm. Length : height (in my specimens) about 2 : 1; length : breadth about 2,2 : 1. Seen from the side the shells of all the specimens from the Antarctic Ocean investigated by me were of about the type reproduced in the accompanying fig. 1, i. e. they agreed fairly well with pl. XVII, fig. 26, G. W. MÜLLER, 1906 a (.) and with G. H. FOWLER's fig. 205. For this character see p. 657 below. Seen from beneath (see the accompanying fig. 2) it has its greatest width at or just in front of the middle and the anterior part of the shell is in most cases somewhat larger than the posterior part; it has fairly uniformly curved side contours, is rather broadly rounded anteriorly, has an almost symmetrical rostrum and is somewhat pointed or narrowly rounded posteriorly. The shoulder vault is weakly developed and rounded. The surface of the shell is bare or has only a few very short hairs. Seen from inside: Selvage: This is comparatively narrow, in most cases it has a whole margin on the rostrum and along the anterior margin of the shell and the anterior half of the ventral margin of the shell and is exceedingly finely serrulated posteriorly. The selvage has no spine-like process on the rostrum. The glands are as stated by G. W. MÜLLER, 1906 a. The dorso-medial glands are somewhat weakly developed. The glands along the posterior margin of the shell are also rather weakly developed; they have their simple exits near the margin of the shell. There is no distinctly developed hinge-socket or hinge-tooth at the posterior dorsal edge of the shell.

* By a misprint: *rotuntata*.

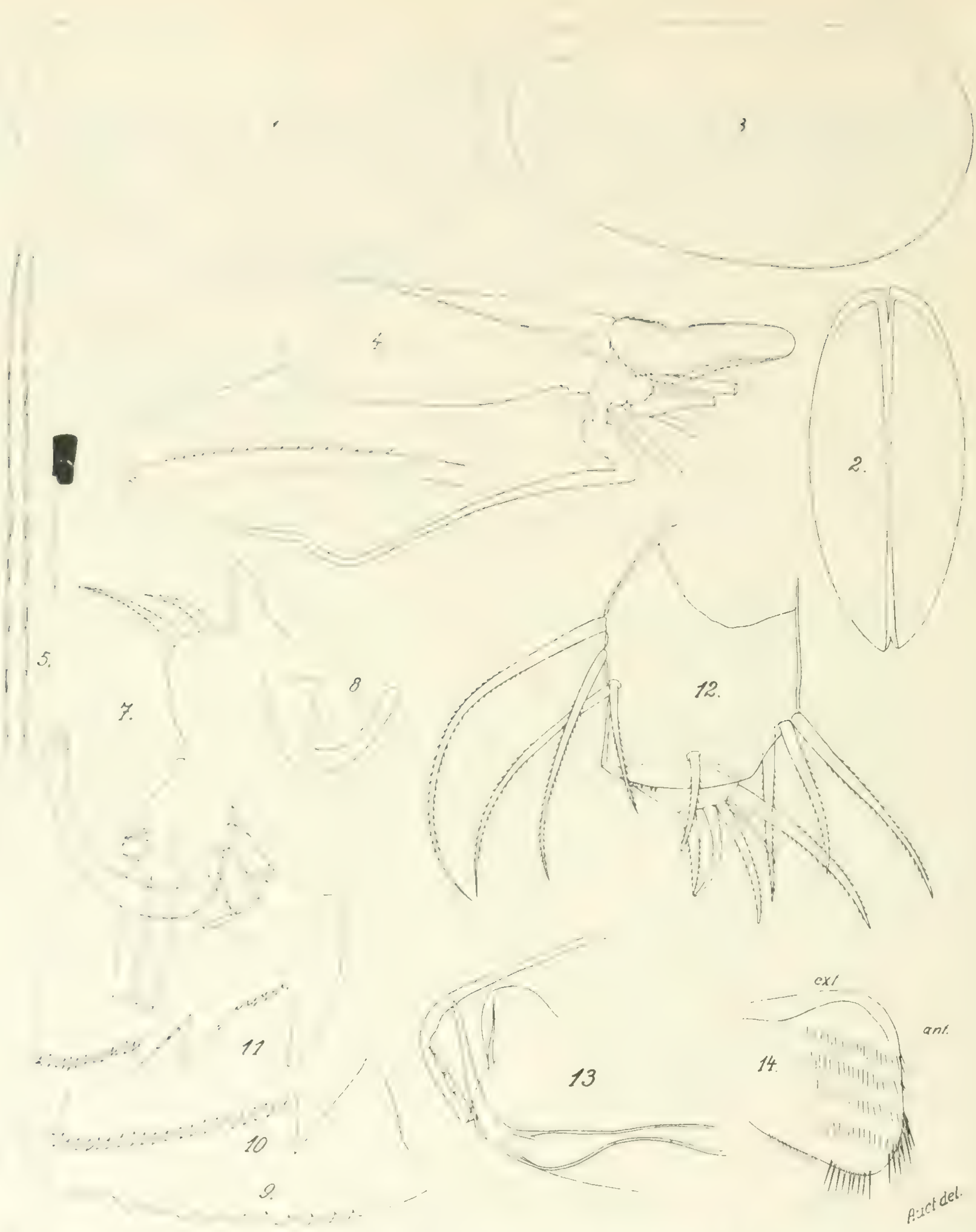

Fig. CXXII. — [illegible] G. W. Müller. 1. Shell seen from the side, ♂; 53 ×. 2. Shell seen from below, ♂; [illegible] ×. 3. Shell seen from the side, ♀; 53 ×. 4. Right first antenna + the rod-shaped organ, the b-, d- and e-bristles are broken. ♂; 167 ×. 5. Equipment of the e-bristle of this antenna, ♂; 453 ×. 6. Equipment of the d-bristle of this antenna, ♂; 833 ×. 7. Endopodite of the right second antenna seen from inside, ♂; 367 ×. 8. Clasping appendage of the endopodite of the left second antenna, ♂; 367 ×. 9. Toothed edge of the pars incisiva of the left mandible seen from inside, ♂; 1033 ×. 10 and 11. Distal and proximal tooth-lists of the right mandible seen from inside, ♂; 1033 ×. 12. Basale + the endopodite of the right maxilla seen from inside, ♀; 400 ×. 13. Distal part of the penis seen from outside; 567 ×. 14. Paragnate, seen from below, ♀; 400 ×. (All these figures are drawn from specimens from station 64 b.)

First antenna: — The first joint is about a third shorter than the second; cf. the accompanying fig. 4. E-bristle: This is about a third longer than this limb and has a distinct knee somewhat distally of the middle. Just proximally of this knee there are two rows of rather narrow, proximally pointing spines, which are in most cases pressed rather close to the bristle. The distal parts of these spines are hyaline and their shape is exceedingly difficult to ascertain with any certainty; as far as I could discover the distal part is about as wide as the proximal part and is not furnished with any appendage that resembles a suctorial organ. In the specimens investigated by me there were fourteen or fifteen spines in each row, all arranged in pairs; cf. the accompanying fig. 5. (In G. W. MÜLLER's pl. XVII, fig. 34, 1906 a, there are, however, only eleven spines, and G. H. FOWLER gives the number as from eight to twelve; cf. pp. 655, 656 below.) The distal spines are rather short and are situated rather close together, the other are somewhat longer and more sparse the more proximally they are situated. Except for these rows of spines this bristle has distally no equipment at all (there are consequently no distally pointing spines such as are found distally of the suctorial plate in *C. elegans*). The part distally of the knee is narrow. Proximally of the rows of spines there are on the anterior side of this bristle sparse, exceedingly short secondary bristles (scarcely perceptible with REICHERT's ocular 4, LEITZ's immersion $^1/_{12}$). The b- and d-bristles are subequal and somewhat shorter than the e-bristle; they have no distinct knee and are furnished with rather few or a moderate number of short, fine, distally pointing spines situated about opposite the distal pairs of spines of the e-bristle; cf. the accompanying fig. 6. These two bristles are also narrow and bare distally. None of these three bristles has pad-like formations. The a-bristle is very long, rather slightly shorter than this limb, often bent at an angle proximally but otherwise in most cases more or less straight; it has no accessory saccules. The c-bristle is straight and short, about a third or a half the length of the capitulum of the rod-shaped organ. All the joints are quite bare.

Second antenna: — Protopodite: In specimens with shells about 1,45 mm. this measured about 0,7 mm. Exopodite: The proportion between the length of this branch and that of the protopodite is about 11 : 20 or 12 : 20. The proportion between the length of the first joint and that of the eight following joints is about 3 : 1. The proportion between the length of the longest natatory bristles and that of this branch is about 4 : 3 or 5 : 3. The first joint has about the same shape as is reproduced below for *C. serrulata*, but is not quite so wide; proximally it has a rather sparse longitudinal row of short, fine spines, of about the same type as in *C. symmetrica* (cf. my fig. 12 of this species), but with far fewer spines. Endopodite: First joint: The processus mammillaris has no distal verruca. The a- and b-bristles have short, fine hairs. Second joint: The c- and d-bristles are comparatively short, in most cases rather considerably shorter than this joint (but not always so short as in the accompanying fig. 7); they have short, fine hairs or are almost bare. The e-bristle is comparatively well developed, about half as long as the two last-mentioned bristles or sometimes even somewhat longer. The g-bristle is about as long as or in most cases somewhat shorter than the length of the protopodite, the f-bristle is rather slightly shorter; the g-bristle is in most cases furnished with sparse, exceedingly short hairs, the f-bristle is bare; none of these is decidedly sword-shaped. Third joint: The clasping organs are of the types reproduced by G. W. MÜLLER, 1906 a,

pl. XVII, fig. 27; cf. the accompanying figs. 7 and 8; both these organs are furnished proximally with one or two verruciform processes and have exceedingly weak transverse creases distally. The h-, i- and j-bristles are subequal, about as long as or somewhat shorter than half the length of the g bristle; they have a proximal part that suddenly becomes very narrow, about the same as in the accompanying fig. 7; they are very thin and hyaline, irregularly rolled up and bare.

Mandible: — Protopodite: Coxale: The toothed edge on the pars incisiva has from twelve to fifteen teeth, the anterior one of which is of about the same relative size and type as in most other species of this genus, the others rather small, subequal, somewhat irregularly triangular (cf. the accompanying fig. 9); some of the posterior teeth are in some cases a little less developed than in this figure, the most posterior one seems, however, almost always to be well developed, sometimes it is even somewhat more powerful than in the above-mentioned figure. Distal tooth-list: This is furnished posteriorly with a rather large and powerful, fang-like, bare tooth, in front of which there is a single row of about 20—25 subequal, rather small, smooth, triangular serrate teeth; cf. the accompanying fig. 10. Proximal tooth list (fig. 11): This varies somewhat in type, but agrees on the whole with the preceding list. It is armed posteriorly with a rather large and powerful, fang-like, bare tooth, in front of which there is a single row of rather small and somewhat irregular pointed serrate teeth. In most cases it has, in addition, unlike what is the case in the distal tooth-list, two or three rather powerful and large fang-like teeth (which are most frequently somewhat smaller than the most posterior large tooth); these have in most cases, at least proximally, some more or less well-developed secondary teeth. The inside of this tooth-list is not furnished with close small spines. Both the tooth-lists are of about the same width and are slightly narrower than the distal toothed edge of the pars incisiva. The masticatory pad is rather high and narrow, about half the width of the tooth-lists, and is divided into about four or five transverse ridges, armed with exceedingly fine, rather short and exceedingly dense spines. The part of the pars incisiva that is surrounded by the row of bristles and hairs is somewhat pad-like and has fine papillae, some of which are exceedingly short. Basale: The six teeth on the distal edge of the endite are rather finely serrulated. The single tooth on the outside of this process is in most cases somewhat smaller than in my fig. 19 of *C. symmetrica*, rather finely serrulated or sometimes even almost smooth. The antero-medial bristle on this joint is comparatively long, in most cases almost as long as the proximo-anterior bristle on the endite of this joint, which is about as long as in my fig. 22 of *C. symmetrica*. There is no epipodial appendage. Endopodite: The first joint has only two posterior bristles, both of which have short hairs; one is situated somewhat laterally and is about as long as or somewhat longer than the total length of the anterior side of the two proximal endopodite joints, the other is situated somewhat medially and is only about a half or a third of the length of the former one. Of the three anterior bristles on the second joint the two longer ones are in most cases somewhat longer comparatively than in my fig. 22 of *C. symmetrica*; one of them is about as long as the longest of the bristles on the end joint; the other is rather slightly shorter. Pilosity: The second endopodite joint has hairs on its anterior side.

Maxilla: — Protopodite: Only the antero-inner tube-bristle on the endite of the procoxale has long secondary bristles. Endite on the coxale: On the posterior process

there are five tube-bristles, not four, as is usually the case in this genus. The outer-anterior bristle on the anterior process is somewhat shorter and weaker relatively than in my fig. 24 of *C. symmetrica.* The basale has no bristles. E n d o p o d i t e (see the accompanying fig. 12): First joint: At about the middle of the anterior side there are four short-haired bristles, three of which are about as long as or somewhat longer than the anterior side of this joint, the remaining one, one of the most distal ones, is about half as long or somewhat more. The end joint is comparatively short and wide, its ventral edge is in most cases not quite so long as the width of the first endopodite joint distally (calculating from front to back), its dorsal edge is about half as long as the ventral edge or rather slightly longer.

F i f t h l i m b: — P r o t o p o d i t e: The longer of the two tube-bristles on the second endite has in most cases short hairs. E n d o p o d i t e: Unlike most species of this genus, this is furnished with nine bristles, as there are two tube-bristles, not, as usual, only one, dorsally of the short claw; one of these two bristles is about as long as the short claw, the other somewhat shorter. The three ventero-anterior bristles on this branch are of about the same type as has been described for *C. oblonga.* This branch has no spines. E x o p o d i t e: This agrees with the type that has been indicated above for *C. obtusata*, but all the ventral bristles on the first joint have short hairs.

S i x t h l i m b: — E n d o p o d i t e: One of the two bristles usually has short hairs. E x o p o d i t e: First joint: At the middle of the ventral side there are two, rarely three, bristles, one of which is relatively long (about as long as the height of this joint) and is furnished with rather long secondary bristles, the other is rather short and in most cases bare or with short hairs. Ventero-distally on this joint there are also two, rarely three, bristles, all rather short and most frequently furnished with short hairs or bare. The dorso-lateral bristle on this joint is relatively short and has short hairs, the dorso-distal one always seems to be absent.

P e n i s: — This is of about the same type as in *C. symmetrica*, but is often of about the same height along the greater part of its length and is somewhat obliquely cut off distally; cf. the accompanying fig. 13. At about the middle it is furnished with a series of about four to six oblique transverse muscles, distally of which there are no muscles. It has a rather large copulatory appendage, of about the type reproduced in the figure just mentioned.

F u r c a: — Behind the claws there is an unpaired short-haired bristle of about the same relative length as in my fig. 33 of *C. symmetrica.*

R o d - s h a p e d o r g a n: — The shaft reaches to about the distal boundary of the second or third joint of the first antenna; the capitulum is always of about the type reproduced by G. W. MÜLLER, 1906 a, pl. XVII, fig. 29, cf. my fig. 4.

U p p e r l i p: — The posterior ventral edge is of a type uncommon in this genus; cf. the accompanying fig. 15. Its combs are sometimes furnished with some weak spine-like processes which decrease in strength medially, about the same as in the figure mentioned, sometimes with rather well-developed hairs. Between the combs there is a narrow, deep notch. The p a r a g n a t e s are triangularly rounded; cf. fig. 14.

F e m a l e:

S h e l l: — Length: This varies within the same limits as in the male. Seen from the side the shells of all the specimens investigated by me were of about the same type

as in pl. XXVIII, fig. 42, G. W. MÜLLER, 1890 a (cf. the accompanying fig. 3), i. e. of the same elongated type as that of the male, but with the posterior part of the shell dominating somewhat more over the anterior part. In other respects it was about the same as that of the male.

F i r s t a n t e n n a: — This is relatively short with a scarcely perceptible boundary between the first and second joints. The second joint has no bristle. The e-bristle is about one and a half or twice as long as this limb; distally on the proximal third of its anterior side it has rather sparse, short, fine hairs; it is not sword-shaped distally. The a-, b-, c- and d-bristles are subequal and about half as long as the e-bristle. There are yellowish-brown pigment corpuscles, at least in some cases, in the proximal part of this limb. All the joints are bare.

Fig. CXXIII. — [illegible] G. W. MÜLLER, ♀. [illegible] Postero-ventral part of the upper lip seen from below, 56[illegible]. (The specimen from station 63 b.)

S e c o n d a n t e n n a: — The p r o t o p o d i t e is only slightly weaker than in the male. The proportion between the length of the protopodite and that of the e x o p o d i t e is about the same as in the male. E n d o p o d i t e: This has two joints, the original boundary between the second and third joint having quite disappeared. The f-, g-, h-, i- and j-bristles are subequal and are about as long as or somewhat longer than half the length of the protopodite; they are all bare and without any shafts. There is an extremely small papilla (scarcely perceptible with REICHERT's ocular 4 and LEITZ's immersion $^{1}/_{12}$) between the h- and i-bristles. One of the c- and d-bristles is developed, at least in some cases; it is very short, only about as long as the proximal width of, for instance, the f-bristle (is this bristle's absence secondary?). Pilosity: The second endopodite joint is bare.

S i x t h l i m b: — E n d o p o d i t e: One of the two bristles is in most cases furnished with short hairs. E x o p o d i t e: The first joint has no dorso-distal bristle; the other bristles vary somewhat in length; they are often of the same relative lengths as in my fig. 30 of *C. symmetrica*.

R o d - s h a p e d o r g a n: — The point of the shaft reaches about as far in front of the point of the first antenna as the length of the capitulum. The capitulum is somewhat more than half the length of the first antenna; it varies in shape; it was found to be of about the same types as are drawn by G. W. MÜLLER, 1906 a, pl. XVII, figs. 30—33.

[illegible] *natural unit?*

Remarks: — Is this species, such as it is taken in the present work, a unit from a systematic point of view? This is a problem at present extremely difficult to decide.

[illegible]

In the original description, which is worked out from „wenige Individuen" caught at a depth of 1000—4000 metres at about the equator in the Pacific Ocean (lat. 100°—120° W.), G. W. MÜLLER gives the following information:

S h e l l: Length, 1.15 mm. Seen from the side it is rather elongated; pl. XXVIII, fig. 42, the shell of a female, seen from the side, shows, as has been pointed out above, a type that agrees fairly closely with the one found by me in the Antarctic.

F i r s t a n t e n n a: The e-bristle in the male is furnished with ten pairs of spines of about the same type and position as has been shown by me above.

R o d - s h a p e d o r g a n: The capitulum varies in type; in the male it is sometimes of the type reproduced by me in fig. 4 above, sometimes almost straight and distally rounded; in the female types were found that resembled rather closely those found by me in the Antarctic specimens.

No difference is mentioned between the male and female shell nor any variation in the shape of the shell, nor is any variation mentioned in the armature of the e-bristle on the male first antenna.

G. W. MÜLLER's description of this species, 1906 a, is based on specimens from the Atlantic, Antarctic and Indian Oceans. The following information is given in this description:

S h e l l: „Von sehr wechselnder Form, das Verhältnis zwischen Höhe und Länge schwankt zwischen $^4/_7$ and $^8/_{19}$" (i. e. about 1 : 1,75 to 1 : 2,37). In short specimens the posterior part of the shell dominated rather strongly over the anterior part, in the most elongated ones the anterior part of the shell was about as large as the posterior part. The posterior margin of the shell was more or less strongly rounded; as a rule the elongated specimens were characterized by a very decided arcuation, the shorter ones, on the other hand, had a somewhat weaker one.

F i r s t a n t e n n a: With regard to the e-bristle it is remarked in the text that it agrees with this bristle in *C. nasotuberculata*; in the latter species this bristle is said to be armed with „etwa" twelve pairs of spines; in pl. XVII, fig. 34 eleven spines are drawn on this bristle.

S e c o n d a n t e n n a: To judge from the figures the c- and d-bristles are developed on the endopodite in the male. For the clasping organs see p. 651 above.

R o d - s h a p e d o r g a n: In the male the capitulum is of about the type reproduced by me in fig. 4 above; in the female this appendage varied within about the same limits as in the Antarctic specimens investigated by me; cf. p. 654 above.

No information is to be found in this treatise as to whether the variation of the shell was continual or whether specimens with different types of shell were found together at the same localities. The statement quoted on p. 649 above as to the length of the shell perhaps indicates that the Antarctic specimens investigated by this author were also all characterized by having elongated shells.

G. H. FOWLER, 1909, looks upon the elongated forms as „Stage I", the short ones as „Stage II"; cf. p. 567 above. With regard to this question this author writes as follows: „According to Dr. MÜLLER, the shells of this species exhibited a remarkable variation in shape, the height being anything from 41 to 57 per cent. of the length. Now in all other *Halocypridae* which I have handled the shell-shape is very fairly constant, and the general contour gives one of the most reliable specific characters, but its diagnostic value would be seriously weakened if so great a range of variation were possible as is shown in MÜLLER's figures, pl. XVII, 23, 24 and 25, 26. Fortunately, it appears that this extreme range of possible contour is due, not to individual variation, but to the different shapes of the shells at Stages I, and II. So far as I have seen

(with the exception of one abnormal specimen) all specimens at Stage I. were of the elongate type; at Stage II. they are never so elongate as at Stage I., although both exhibit a certain amount of individual variation."

The following information is found in the work mentioned:

S h e l l: „Stage I": The male shell is of about the type reproduced by me in fig. 1 above, but not quite so elongated (length : height = about 1,9 : 1). The female shell is somewhat more elongated than the one given by me in fig. 3 above („length may be more than twice the height"). „Stage II": The male shell is rather short and high, of about the type reproduced by G. W. MÜLLER, 1906 a, pl. XVII, fig. 23. Length : height = about 1,7 : 1. The female shell is still higher; length : height = about 1,4—1,5 : 1.

F i r s t a n t e n n a: „Stage I": The e-bristle in the male is furnished with from ten to twelve pairs of spines of the same type and position as has been described by me above. „Stage II": This bristle is armed with eight or nine similar pairs of spines.

S e c o n d a n t e n n a: „Stage I": The male endopodite is characterized by clasping organs similar to those reproduced by me above (figs. 7 and 8). The c- and d-bristles („basal bristles", according to G. H. FOWLER's terminology) are developed. „Stage II": The clasping organ on the right male endopodite has a marked proximal bend (fig. 209); „with no basal bristles".

„R o d - s h a p e d o r g a n: ♂: „Stage I": Of the type reproduced by me above, fig. 4. „Stage II": „The general type is that of Stage I, but shorter and plumper". ♀: In both „Stage I" and „Stage II" rather variable; the same types as G. W. MÜLLER observed were found.

Do „Stage I" and „Stage II" really represent two succeeding stages of one and the same species? I believe that this question must be answered in the negative. The fact which in my opinion forms the strongest argument against this theory of G. H. FOWLER's is that in my Antarctic material the oldest larvae were of about the same elongated type as the mature specimens. For further information on this point see p. 567 above.

How are we to look upon „Stage II"? As is shown by the quotation given above the variation in shell-shape was not continuous in the material investigated by G. H. FOWLER; two centres of variation could be distinguished. This indicates, of course, that the material was not pure from a systematic point of view. It does not seem to me improbable that „Stage II" belongs to a species very closely related to *C. rotundata* that has already been described by G. W. MÜLLER, 1906 a; this species is *C. nasotuberculata*. The reasons for this view are as follows: The shell of *C. nasotuberculata* has about the same shape as „Stage II"; the length also agrees fairly well; cf. G. H. FOWLER, p. 273. The clasping organ of the endopodite on the right second antenna in the male is in this species of a type closely resembling that which is characteristic of „Stage II"; cf. G. W. MÜLLER's fig. 30, pl. XVIII, 1906 a with G. H. FOWLER's fig. 209; in both are found what G. W. MÜLLER describes as: „mit außen wenig abgerundeter rechtwinkliger Ecke". In addition we must note the great resemblance between the rod-shaped organ in pl. 6, fig. 18, G. W. MÜLLER, 1894 and G. H. FOWLER's fig. 208. This figure in G. W. MÜLLER is reproduced from a specimen of the same short type of shell and with a similarly shaped clasping organ on the male right second antenna as in „Stage II". In the work just mentioned it was

defined by G. W. MÜLLER as *C. rotundata*, in a later work, 1906 a, as *C. nasotuberculata**. It is, however, to be noted that „Stage II“, according to G. H. FOWLER, has no c- and d-bristles on the endopodite of the male second antenna. These bristles are, at least if we are to judge from G. W. MÜLLER's pl. 6, figs. 10 and 11, 1894, developed in *C. nasotuberculata*. It would perhaps be best to say that the systematic position of „Stage II“ is uncertain.

Besides the fact that G. H. FOWLER found that the variation of the shell was not continuous in the material investigated by him the circumstance that exclusively elongated specimens were found in G. W. MÜLLER's sample from the Pacific Ocean and my samples from the Antarctic may perhaps indicate that two very closely related forms — perhaps overlapping in their variation — have been mixed together. A certain decision in this question would necessitate, however, a very careful investigation of an abundant material. It is therefore desirable that future investigators should give very accurate information with regard to the variation in the material of this „species“ investigated by them.

In G. W. MÜLLER's work of 1906 a we find (p. 79) that *Halocypris punica* TH. SCOTT (1894, p. 143, pl. XV, figs. 7, 8, 39, 40) is given as a probable synonym of one of the species belonging to the *Rotundata* group: „welcher Art, das läßt sich bei der mangelhaften Darstellung von SCOTT nicht feststellen“. This writer, in his work of 1912, puts this species of SCOTT's as a synonym of *C. rotundata*, but adds a query. It did not seem to me convenient to include this name in the list of synonyms given above, as there is no close resemblance between these forms; on the contrary there are rather essential differences to be noted both in the shape of the shell and in the second antenna and the rod-shaped organ. As far as I can see, this species of SCOTT's is not synonymous with any other species hitherto described.

In G. W. MÜLLER's work of 1912 *C. rotundata*, G. W. MÜLLER, 1894, is also included as a synonym of this species. The reason why this name was not included in the list of synonyms given above will be seen from what has been said above. In addition I may point out the rather great difference that seems to exist between the penis in the form investigated by me and that of the Mediterranean form; see G. W. MÜLLER, pl. 6, fig. 20, 1894.

C. rotundata, LO BIANCO, 1903, p. 199, is not given in the list of synonyms as it lacks verificatory informations and drawings. „*C. rotundata*“ of this author, 1904, p. 45 is also uncertain; with a very superficial drawing.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth, 2500—0 m.; 23. VI. 1902; temperature at the surface, 7.90° C.; 7 mature males and 9 mature females; R. M. S. 235. S. A. E., Pl. station 65 b; at the same locality; depth 400—0 m.; 23. VI. 1902; temperature at 400 m., 3,95° C.; 1 juvenis; R. M. S. 236. S. A. E., Pl. station 66 b, at the same locality; depth,

* The state of affairs is, however, particularly complicated. It is true that G. W. MÜLLER writes 1906 a that one of the Naples specimens was to be referred to *C. nasotuberculata*, but in 1912, p. 77, however, the same author writes „*C. rotundata*, G. W. MÜLLER, 1894“ as a synonym of *C. rotundata* G. W. MÜLLER, 1890 a. In the description of *C. nasotuberculata* it is stated that the rod-shaped organ is constant; the type shown in pl. XVIII, fig. 28 differs, however, considerably from the figures of the same organ in 1894. It is to be noted that in the work of 1912 *C. rotundata* is not included at all as a synonym of *C. nasotuberculata*.

200—0 m.; 23. VI. 1902; temperature at 200 m., 5°.25 C.; 1 juvenis; R. M. S. 237. S. A. E., Pl. station 70 b, lat. 49° 56′ S., long. 49° 56′ W.; depth, 2700—0 m.; 27. VI. 1902; temperature at 2700 m. and at the surface, − 1°.67 C. and 3°.40 C. resp.; 2 mature males, 3 mature females and 1 juvenis; R. M. S. 238.

Distribution: — According to G. W. MÜLLER in the Atlantic, Indian and Pacific Oceans. In the Atlantic (Antarctic Ocean) as far as lat. 65° S.

The specimens investigated by me were caught in the region of distribution previously known.

Conchoecia isocheira G. W. MÜLLER.

Conchoecia isocheira, G. W. MÜLLER, 1906 a, p. 84; pl. XIV, figs. 28—31; pl. XV, figs. 30—33.
„ „ „ „ „ 1906 c, p. 4.
„ „ „ „ „ 1908, p. 70.
„ „ „ „ „ 1912, p. 77.

Description: — See G. W. MÜLLER, 1906 a, p. 84.

Supplementary description: — Male: —

Shell: — Length: According to G. W. MÜLLER, 0.9 mm. The specimens investigated by me were also of this length. Length : height about 1.7 : 1; length : breadth about 2,3 : 1. Seen from the side it is of the type described by G. W. MÜLLER. Seen from below it has its greatest width at about the middle, with uniformly and rather strongly curved side contours, the anterior end rather narrowly rounded, with about a symmetrical rostrum, the posterior end somewhat pointed and the anterior and posterior ends of the shell about the same size; cf. the accompanying fig. 2, ♂. The shoulder vault is very weakly developed and well rounded. The surface of the shell is bare or has only a few exceedingly short hairs. Seen from inside: Selvage: This is of the same type as in *C. rotundata* or else it is practically quite smooth-edged. The glands are as established by G. W. MÜLLER; it is to be noted that the dorso-medial glands are quite absent both in males and females, contrary to what is the case in *C. rotundata*, in which, though weak, they are found in the male, and unlike in most other species of this genus. The medial glands along the posterior margin of the shell are about similar to those of *C. rotundata*. There is no distinctly developed hinge-socket or hinge-tooth at the posterior dorsal corner of the shell.

First antenna: — This is of the type described and reproduced by G. W. MÜLLER. E-bristle: This has from seven to nine spines situated in a single row. Each of these spines has distally a moderately large, oval, hyaline appendage (something like a suctorial organ; cf. the accompanying figs. 3 and 4). The secondary bristles on the anterior side of this bristle are like those of *C. rotundata*. The b- and d-bristles have a moderate number or rather few exceedingly fine distally pointing spines at about the corresponding place to that of the spines

on the e-bristle. None of these three bristles is widened distally or has a pad-like appendage. All the joints are quite bare.

Second antenna: — Protopodite: Length 0,3—0,4 mm. Exopodite: The proportion between the length of this branch and that of the protopodite is about 10 : 13. The proportion between the length of the first joint and the total length of the eight following joints is about 10 : 4. The proportion between the length of the longest natatory bristles and that of this branch is about 14 : 10. As far as I could observe the first joint is quite bare. Endopodite: This is of about the type described and repro-

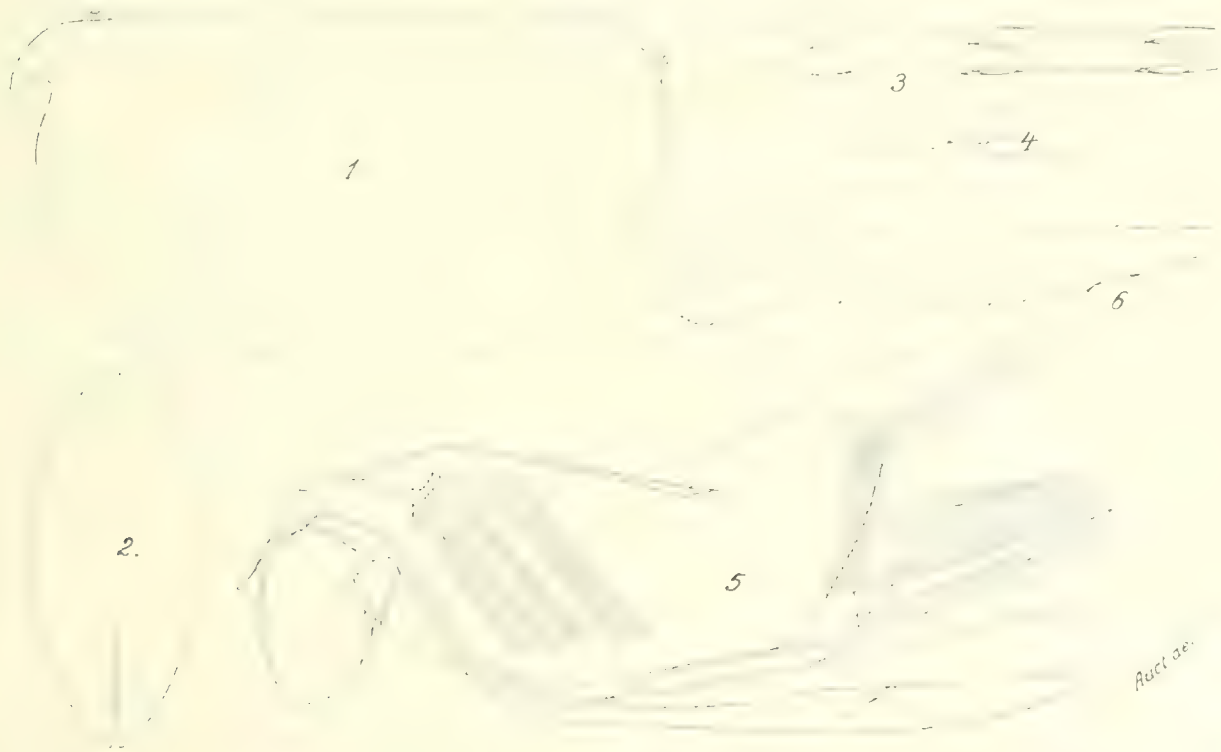

Fig. CXXIV. *Conchoecia isocheira* G. W. Müller. — 1. Shell seen from the side, ♂; 87 ×. 2. Shell seen from below, ♀; 50 ×. 3. and 4. Equipment of the e-bristle on the first antenna, ♂; 1200 ×. 5. Penis seen from outside; 387 ×. 6. Distal part of the rod-shaped organ and the first antenna, ♀; 567 ×. (All these figures are drawn from specimens from station 54 b.)

duced by G. W. Müller; the length of the f- and g-bristles bears a proportion of about 2 : 3 to the length of the protopodite. The a- and b-bristles have short hairs, the other bristles are bare.

Mandible: — Protopodite: Coxale: The toothed edge of the pars incisiva is of about the same type as in *C. rotundata*, but its teeth, apart from the large anterior one, are somewhat smaller relatively; this part may be described as evenly and finely serrulated; the number of the teeth is somewhat larger than in the species mentioned, about 14—18 were observed. The distal tooth-list is of about the same type as in *C. rotundata*. The proximal tooth-list is also of about the same type as in this species, but the number of its teeth seems

in most cases to be somewhat smaller. In other respects the pars incisiva agrees with the same organ in *C. rotundata*. Basale: Of the six teeth on the distal edge of the endite the five anterior ones are rather powerfully serrulated, the sixth is only slightly serrulated or is quite smooth. Both the appendages behind these six teeth are of the tube-bristle type. The single tooth on the outside of this endite is very small, about as large as the distal teeth. The bristles of this joint are like those of *C. rotundata* and as in the species mentioned, no epipodial appendage is developed. Endopodite: The first joint has only one posterior bristle, which has short hairs, is about as long as the anterior side of this joint and is situated somewhat laterally. Second joint: Of the three anterior bristles the two shorter ones are often subequal and about as long as the anterior side of the two distal joints or somewhat shorter. Of the two posterior bristles on this joint the longer one is in most cases about as long as the two shorter anterior ones, the other is about half as long or somewhat longer.

Maxilla: — This is of the same type as in *C. rotundata*.

Fifth limb: — Of the same type as in *C. rotundata*, but sometimes all the bristles on the endopodite and the dorso-lateral bristle of the first exopodite joint have short hairs; sometimes one of the ventero-proximal bristles on the first exopodite joint may be furnished with long hairs.

Sixth limb: — Endopodite: Both the bristles sometimes have short hairs; sometimes, however, both are even furnished with rather long hairs. Exopodite: First joint: This has the same bristles as in *C. symmetrica*, but has no dorso-distal bristle. The bristles are of about the same relative length as in the species mentioned or sometimes somewhat longer; they are either all furnished with rather long hairs or else one or two of them have short hairs. Third joint: The dorsal bristle is relatively long, often about twice as long as the ventral one.

Penis: — This is of the type usual in this genus. At about or somewhat distally of the middle there are about four oblique transverse muscles, distally of which there are no muscles. In the three specimens investigated by me the bent distal part of the vas deferens was twisted forward in the way shown in the accompanying fig. 5. There seems to be no sign of any copulatory appendage.

The furca, upper lip and paragnates are similar to those of *C. rotundata*.

Rod-shaped organ: — The shaft reaches to about the distal boundary of the second joint of the first antenna or somewhat farther. The capitulum is of the type reproduced by G. W. MÜLLER; it is about as long as the second joint of the first antenna.

Female: —

Shell: — Length: According to G. W. MÜLLER, „ziemlich konstant 1,07 mm". The specimens investigated by me measured 0,95—1 mm. Length : height about 1,8 : 1. Seen from the side it is of the type described by G. W. MÜLLER; cf. the accompanying fig. 1. Seen from below it was of about the same type as the male; cf. the accompanying fig. 2. In other respects it was like that of the male.

First antenna: — This is of the type reproduced by G. W. MÜLLER. I did not succeed in finding hairs on the anterior side of the proximal part of the e-bristle. All the joints

are bare. Yellowish-brown corpuscles of pigment are found at least in the proximal part of this antenna.

Second antenna: — The endopodite is of the same type as in *C. rotundata*, but I never found either of the c- and d-bristles developed.

Sixth limb: — Of about the same type as in *C. rotundata*.

Rod-shaped organ: — This is sometimes of the type described and reproduced by G. W. MÜLLER, sometimes somewhat pointed distally; cf. the accompanying fig. 6.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 317, lat. 53° 0′ S., long. 48° 27′ W.; depth, 250—0 m.; 17. IV. 1902; temperature at 250 m. and at the surface, + 3°,40 C. and + 1°,30 C.: 1 mature female; R. M. S. 340. S. A. E., Pl. station 318; at the same locality; depth, 500—0 m.; 17. IV. 1902; temperature at 500 m., + 1°,50 C.: 1 mature female; R. M. S. 341. S. A. E., Pl. station 44 b, lat. 65° 56′ S., long. 54° 35′ W.; depth, 700—0 m.; 22. I. 1902; temperature at the surface — 1°,15 C.: 3 mature males 4 mature females and 1 juvenis; R. M. S. 239.

Distribution: — In the Antarctic Ocean S. of lat. 55° S.

A couple of my above-mentioned finds thus come from localities somewhat north of the previously known region of distribution.

Curta group G. W. MÜLLER.

(*Mikroconchoecia* C. CLAUS.)

This group, which includes two forms in addition to the two dealt with below, is certainly quite a natural one. The careful comparative investigation to which I subjected the two following species affords, at any rate, very strong evidence in favour of this.

Conchoecia curta J. LUBBOCK.

For synonymy see G. W. MÜLLER, 1906 a, p. 86.

Description: — C. CLAUS, 1891 a, p. 73; pl. XX and G. W. MÜLLER, 1906 a, p. 86; pl. XXX, figs. 1—9.

Supplementary description: — Male: —

Shell: — Length: According to G. W. MÜLLER, 0,75—0,95 mm. The specimens investigated by me measured 0,7—0,9 mm. Length : height about 1,6 : 1; length : breadth about 1,75 : 1. Seen from the side it is of the type described and reproduced by G. W. MÜLLER; cf. the accompanying fig. 1. Seen from below (fig. 2) it has its greatest

width at about the middle and the anterior part of the shell considerably larger than the posterior part; the side contours are rather decidedly concave just behind the middle, apart from which they are evenly curved; the anterior and posterior ends are broadly pointed, the rostrum is almost symmetrical. The shoulder vault is rather well developed and always well rounded. The surface of the shell is bare and has a sculpture of the type reproduced by G. W. MÜLLER. Seen from inside: Selvage: This is in most cases smooth on the rostrum and along the anterior margin of the shell and the anterior half of the ventral margin of the shell; posteriorly it is exceedingly finely serrulated. It has no spine-like process on the rostrum. The glands are as described by G. W. MÜLLER; the left unsymmetrical gland has its exit just at the posterior dorsal corner of the shell. There is an almost complete absence of medial glands along the posterior margin of the shell (apart, of course, from the dorsal medial glands that are well developed); the few that are found emerge with single pores a short distance inside the margin of the shell. At the posterior dorsal corner there is a well developed hinge-socket and hinge-tooth; see the accompanying fig. 4 (♂ = ♀).

First antenna: — The first joint is somewhat shorter than the second. The boundary between the original second and third joints is scarcely or not at all developed. The b-, d- and e-bristles are in most cases subequal, about one and a half times the length of this limb or somewhat shorter. The e-bristle is armed with from eight to thirteen spines, according to G. W. MÜLLER; in C. CLAUS's figures (1891 a) there are from seven to fourteen; on the specimens investigated by me I counted from eleven to thirteen; these spines agree with the type reproduced by C. CLAUS, 1891 a. Proximally of the spines there are sparse and very short secondary bristles on the anterior side of this bristle. These three bristles are bent at an angle, which is in most cases a rather decided one, at about two-thirds of the way along them; they are not widened distally and have no pad-like formations. G. W. MÜLLER states that the b- and d-bristles are bare; in the specimens investigated by me I was able in most cases to find a few short, fine, distally pointing hairs about opposite the spines of the e-bristle. The a- and c-bristles are of about the types shown in pl. XX, fig. 17, C. CLAUS, 1891 a. All the joints are quite bare.

Second antenna: — Protopodite: In specimens with shells 0,8 mm. long this measured about 0,4 mm. Exopodite: The proportion between the length of this branch and that of the protopodite is about 10 : 16. The proportion between the length of the first joint and the total length of the eight distal joints is about 10 : 4. The longest natatory bristles are about a quarter longer than this branch. The first joint is bare. Endopodite: First joint: The processus mammillaris has no distal verruca and is comparatively small. The a- and b-bristles have short hairs. Second joint: The c-, d- and e-bristles are of about the same relative lengths as in the figures 13 and 14 of *C. symmetrica*. The g-bristle is, as a rule, somewhat longer than the protopodite, somewhat sword-shaped distally and furnished with exceedingly short and fine hairs. The f-bristle is somewhat shorter than the protopodite, narrow, bare and furnished with very short and fine hairs. Third joint: The clasping organs are of about the types reproduced by G. W. MÜLLER, 1906 a, pl. XXX, figs. 4—7; they have rather decided transverse creases distally. The h-, i- and j-bristles are subequal, about half the length of the g-bristle

and about as wide as the f-bristle proximally, bare or with extremely short and fine hairs. The h-bristle has a spinous shaft, the f-, g-, i- and j-bristles have no shafts.

Mandible: — Protopodite: Coxale: The toothed edge of the pars incisiva has about ten teeth. The distal tooth-list is of about the same relative size and type as has been previously described for *C. oblonga*, but the number of teeth is on the average somewhat fewer. The proximal tooth-list also varies within about the same limits as the corresponding part in the species just mentioned, but here, too, the number of teeth is on the average somewhat less. The masticatory pad is very powerfully developed; it is divided into from four to six more or less distinct transverse ridges; the distal one of these is about as wide as the two tooth-lists, the next distal one is about half as wide, the others decrease somewhat in width the more proximally they are situated. The whole masticatory pad is armed with rather small papillae, placed close together. The part of the pars incisiva that is surrounded by the lancet bristles and hairs is rather powerful and is armed with papillae similar to those on the masticatory pad; this part is also armed with a couple of low and powerful teeth. Basale: The six teeth on the distal edge of the endite are furnished with moderately fine serrulation. The single tooth on the outside of this endite is more powerful than in my fig. 19 of *C. symmetrica* and is of the same type as has been described for *C. elegans*. The epipodial verruca is very small and has a very short bristle. The exopodite verruca is very weakly developed. Endopodite: The first joint has only two posterior bristles, both with short hairs; these have about the same position and relative length as the two corresponding bristles in *C. rotundata*. Pilosity: The second endopodite joint has hairs.

Maxilla: — Protopodite: Endite on the procoxale: Besides the anterior inner tube-bristle the two bristles nearest to this are also provided in most cases with long secondary bristles. The basale has no bristle. Endopodite: First joint: The six bristles on the anterior side of this joint are somewhat relatively shorter than in most other species of this genus. The end joint is of about the same type as in *C. rotundata*.

Fifth limb: — Protopodite: The longer of the two tube-bristles on the second endite has short hairs. Endopodite: This is similar to that of *C. oblonga*. Exopodite: The first joint is similar to that of the above-mentioned species, but all the ventral bristles usually have short hairs. The ventral end claw varies in length; sometimes it is only a quarter or a sixth of the length of the middle claw.

Sixth limb: — Exopodite: The ventral bristles on the first joint are sometimes somewhat relatively shorter than in my fig. 29 of *C. symmetrica*; the dorso-lateral and dorso-distal bristles sometimes seem to be quite absent.

Penis: — This is of the type reproduced by G. W. MÜLLER, 1906 a, pl. XXX, fig. 9; it has a rather narrow copulatory appendage; cf. the accompanying fig. 5.

Furca: — There is no unpaired bristle behind the claws.

Rod-shaped organ: — The shaft reaches to about the distal boundary of the second joint of the first antenna or somewhat farther. The capitulum is of about the type described and reproduced by G. W. MÜLLER or else it is somewhat more curved in anteriorly; cf. the accompanying fig. 6; it is sometimes somewhat more pointed distally than in

G. W. MÜLLER's and my figure; the proportion between its length and that of the second joint of the first antenna is about 4 : 5.

Upper lip: — The part between the combs on the postero-ventral edge of this lip is rather deeply and narrowly notched; it is not quite as deep as in my fig. 15 of *C. rotundata*. The paragnates are of about the same type as in *C. symmetrica*.

Female: —

Shell: — Length: According to G. W. MÜLLER, 0,8—0,95 mm. The specimens measured by me were 0,7—0,85 mm. long. Length : height about 1,4 : 1. Seen from the side it has about the same shape as is described by G. W. MÜLLER; cf. the accompanying

Fig. CXXV. *Conchoecia curta* J. LUBBOCK. — 1. Shell seen from the side, ♂; 82 ×. 2. Shell seen from below, ♂; 82 ×. 3. Shell seen from the side, ♀; 82 ×. 4. Postero-dorsal part of the shell seen from inside, ♀; 567 ×. 5. Distal part of the penis seen from outside; 833 ×. 6. Distal part of the rod-shaped organ, ♂; 400 ×. 7. Distal part of this organ + a part of the first antenna, ♀; 567 ×. (From specimens from station 134.)

fig. 3. Seen from below it is of about the same type as in the male, but the anterior part is scarcely perceptibly larger than the posterior part and the side contours are not curved in or scarcely perceptibly so just behind the middle. The left unsymmetrical gland has its exit somewhat ventrally of the postero-dorsal corner of the shell; see the accompanying fig. 4. In other respects it is like that of the male.

First antenna: — The division into joints is rather weak. The first joint is, as is the case in the male, somewhat shorter than the second. The boundary between the original second and third joints is in most cases rather well developed. The bristle of the second joint has short hairs or is almost bare; it is somewhat shorter than this joint (fig. 7). E-bristle:

This is about one and a half times the length of this limb or somewhat longer. The simple sensorial filament, the d-bristle, is in most cases not quite a third of the length of the e-bristle. All the joints are bare.

Second antenna: — Protopodite: In specimens with shells 0,7 mm. long this measured about 0.25—0.28 mm. Exopodite: The proportion between the length of this branch and that of the protopodite is about 10 : 11. The proportion between the length of the first joint and the total length of the eight following joints is about the same as in the male. The natatory bristles are also of the same relative length as in the other sex. Endopodite: This has two joints, the boundary between the original second and third joints not being developed. Second joint: The g-bristle is of about the same type and relative length as in the male. The f-, h-, i- and j-bristles are subequal and about a third shorter than the g-bristle, bare or furnished with sparse short hairs and without any shafts; otherwise they are of about the same type as in the male. There is a small papilla between the h- and i-bristles. Pilosity: The second endopodite joint is bare.

Sixth limb: — Endopodite: One of the two bristles sometimes has short hairs. Exopodite: First joint: One or more of the ventral bristles often have short hairs. The dorso-distal bristle is short; in some cases it seems to be quite absent. The dorsal one of the three bristles on the end joint is often only half the length of the middle one.

Rod-shaped organ: — This is of about the type described and reproduced by G. W. MÜLLER. Its point reaches about as far as the point of the first antenna or only rather slightly distally of this; cf. the accompanying fig. 7.

Remarks: — The synonymy of this species is exceedingly complicated and it seems impossible at present to unravel it with any certainty. In the present work I have entirely followed the view adopted by G. W. MÜLLER, 1906 a and merely refer to this writer's exposition. *Synonyms.*

Conchoecia curta, J. LUBBOCK, 1860, p. 16 (188) is mentioned by the following authors: G. W. MÜLLER, 1906 a, p. 86, 1906 b, p. 5, 1908, p. 70, 1912, p. 77, G. H. FOWLER, 1909, pp. 231, 259, 284, B. KAJDIŽ, 1912, p. 939 and L. SCHWEIGER, 1912, pp. 260, 262, 263, 271.

C. rostrata (J. LUBBOCK, 1860, p. 17 [189]) is only mentioned by G. W. MÜLLER, 1906 a, p. 86, 1906 b, p. 5 and 1912, p. 77.

C. Clausi (G. O. SARS, 1887, p. 87 [259]) is mentioned by the following authors: C. CLAUS, 1888, p. 153, 1890, p. 22, 1891 a, p. 73, 1894, p. 3, G. W. MÜLLER, 1894, p. 230, 1906 a, p. 86, 1906 b, p. 5, 1908, p. 70, 1912, p. 77, G. S. BRADY and A. M. NORMAN, 1896, p. 700, G. S. BRADY, 1897, p. 97, 1902 a, p. 199 (= 1903, pp. 337, 338), P. T. CLEVE, 1900, p. 39, 1904, p. 370, 1905, p. 131, S. LO BIANCO, 1903, pp. 148, 150, 199, 229, 230, 1904, p. 45, A. M. NORMAN, 1905, p. 155, A. SCOTT, 1905, p. 370, V. VÁVRA, 1906, p. 61, CH. JUDAY, 1906, p. 23, C. H. OSTENFELD and C. WESENBERG-LUND, 1909, p. 113 and O. de BUEN, 1916, p. 364.

During my re-examination of the original material I verified that *C. (= Microconchoecia) Clausii* (P. T. CLEVE, 1900) is a synonym of the form dealt with by me above.

Habitat: — Atlantic Ocean:

S. A. E., Pl. station 19, lat. 36° 13′ N., long. 17° 16′ W.; at the surface; 4. XI. 1901; temperature, 18°.5 C.; 2 mature males and 1 juvenis; R. M. S. 243. S. A. E., Pl. station 26, lat. 32° 21′ N., long. 19° 8′ W.; at the surface; 6. XI. 1901; temperature, 20,5° C.; 1 mature male and 1 mature female; R. M. S. 245. S. A. E., Pl. station 34, lat. 27° 49′ N., long. 20° 51′ W.; at the surface; 8. XI. 1901; temperature, 21.4° C.; 10 mature males and 12 mature females (some of the females = *C. echinulata*?); R. M. S. 247. S. A. E., Pl. station 4 b, lat. 25° 51′ N., long. 21° 29′ W.; at the surface; 9. XI. 1901; temperature, 22.50° C.; 1 mature male. S. A. E., Pl. station 8 b and 46, lat. 21° 51′ N., long. 23° 0′ W.; at the surface; 11. XI. 1901; temperature, 23.20° C.; 1 mature male and 1 mature female; R. M. S. 242 and 248. S. A. E., Pl. station 116, lat. 15° 46′ S., long. 34° 8′ W.; at the surface; 1. XII. 1901; temperature, 26,2° C.; 1 mature female. S. A. E., Pl. station 23 b, lat. 19° 19′ S., long. 36° 9′ W.; at the surface; 3. XII. 1901; temperature, 25.2° C.; 16 mature males and 23 mature females (some of the females = *C. echinulata*?); R. M. S. 244. S. A. E., Pl. station 134, lat. 24° 21′ S., long. 41° 23′ W.; at the surface; 6. XII. 1901; temperature 23.2° C.; 1 mature male, 7 mature females and 5 juvenes; R. M. S. 250. S. A. E., Pl. station 28 b, lat. 26° 58′ S., long. 44° 57′ W.; at the surface; 8. XII. 1901; temperature, 22.9° C.; 1 mature male and 1 mature female; R. M. S. 246.

Lat. 42° 09′ N., long. 42° 15′ W.; 17. III. 1898; 1 mature male; R. M. S. 381. Lat. 40° 30′ N., long. 16° 5′ W.; 4. IV. 1899; 3 specimens; R. M. S. 382 (= the specimens of P. T. CLEVE, 1900).

Distribution: — According to G. W. MÜLLER in the Atlantic (from lat. 31° N. to lat. 37° S.), Indian and Pacific Oceans.

Some of the localities of the Swedish South Polar Expedition are thus somewhat north of the area of distribution in the Atlantic fixed by the above writer and those noted by P. T. CLEVE lie still more to the north.

Conchoecia echinulata (C. CLAUS).

Mikroconchoecia echinulata, C. CLAUS, 1891 a, pl. XX.
Conchoecia ,, G. W. MÜLLER, 1906 a, p. 88; pl. XXX, figs. 10—17.
,, ,, ,, ,, ,, 1908, p. 70.
,, ,, ,, ,, ,, 1912, p. 78.

Description: — See G. W. MÜLLER, 1906 a, p. 88.

Remarks: — In the characters not mentioned by G. W. MÜLLER this species agrees well with *C. curta*. It is to be noted that a copulatory appendage is developed on the penis, but it is considerably narrower than in the species mentioned; cf. the accompanying fig. 1.

Habitat: — Atlantic Ocean:

S. A. E., Pl. station 23, lat. 34° 2′ N., long. 18° 21′ W.; at the surface; 5. XI. 1901; temperature, 20.1° C.; 3 mature males, 5 mature females and 3 juvenes; R. M. S. 251. S. A. E.,

Pl. station 30, lat. 29° 52′ N., long. 20° 14′ W.; at the surface; 7. XI. 1901; temperature, 21,1° C.: 1 mature male and 7 mature females (all the females belonging to this species?); R. M. S. 252. S. A. E., Pl. station 34, lat. 27° 49′ N., long. 20° 51′ W.; at the surface; 8. XI. 1901; temperature, 21,4° C.: 1 mature male (see *C. curta*, p. 666 above). S. A. E., Pl. station 38, lat. 25° 46′ N., long. 21° 31′ W.; at the surface; 9. XI. 1901; temperature, 22,5° C.: 1 mature male; R. M. S. 253. S. A. E., Pl. station 23 b, lat. 19° 19′ S., long. 36° 9′ W.; at the surface; 3. XII. 1901; temperature, 25,2° C.: 2 mature males (see *C. curta*, p. 666).

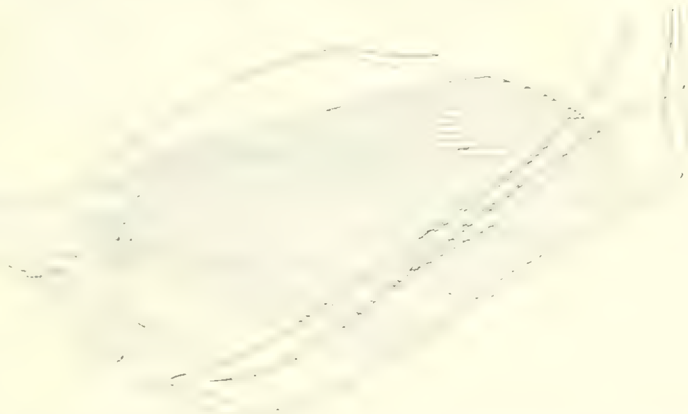

Fig. CXXVI. — *Conchoecia echinulata* (C. CLAUS), ♂. — 1. Penis seen from outside; 340 ×. (From a specimen from station 23 b.

Distribution: — „Die „Valdivia" fischte diese Art zwischen dem 26° s. Br. und dem 37° s. Br. und außerdem einmal unter 31° n. Br. Auch nach den Gauß-Fängen scheint die Art in einer breiten äquatorialen Zone zu fehlen. Atlantischer, Indischer Ozean" (G. W. MÜLLER, 1908, p. 70).

The finds mentioned above seem scarcely to support this idea. Probably this species is distributed all over the central part of the Atlantic Ocean.

Bispinosa group G. W. MÜLLER.

According to G. W. MÜLLER this group comprises, in addition to the forms dealt with below, three other species, namely *C. striola* G. W. MÜLLER, *C. atlantica* (J. LUBBOCK) and *C. orthotrichota* G. W. MÜLLER. To these may be added the forms included by this writer as synonyms of *C. bispinosa*, namely *C. secernenda* V. VÁVRA and *C. Mülleri* CH. JUDAY.

Of these species *C. Haddoni*, *C. bispinosa* and *C. striola* are, as G. W. MÜLLER has pointed out, certainly very closely related to one another. It is difficult to say anything certain as to the systematic position of *C. secernenda* and *C. Mülleri* (cf. pp. 674, 675 below), but at any rate they are very close to the three species just mentioned.

On the other hand *C. atlantica* and *C. orthotrichota* are, according to G. W. MÜLLER, more isolated; it is less certain that they belong to this group. I was unfortunately unable to investigate material of these species, so that it is not possible for me to give any further opinion in this question.

Conchoecia Haddoni G. S. Brady and A. M. Norman.

Conchoecia Haddoni, G. S. Brady and A. M. Norman, 1896; p. 690; pl. LXIV, figs. 6—16.
" " G. W. Müller, 1901, p. 9; fig. 17 (= a reproduction of the original description).
" " P. T. Cleve, 1905, p. 130.
" " G. W. Müller, 1906 a, p. 89; pl. XVIII, figs. 1—10.
" " V. Vávra, 1906, p. 49; pl. IV, figs. 65—75.
" " G. W. Müller, 1908, p. 70.
" " G. H. Fowler, 1909, pp. 235, 264, 287; pl. XVIII, XIX, figs. 73—89.
" " C. H. Ostenfeld and C. Wesenberg-Lund, 1909, p. 113.
" " G. W. Müller, 1912, p. 78.

Description: — See G. W. Müller, 1906 a, p. 89 and V. Vávra, 1906, p. 49.

Supplementary description: Male:

Shell: — Length: G. S. Brady and A. M. Norman give this as 2,55 mm. G. W. Müller, 1906 a says: „Die Tiere scheinen sich ziemlich scharf in eine kleinere nördliche Rasse (♀ bis 2,6, ♂ nur bis 1,9) und eine größere südliche Rasse (♀ 2,6—2,95, ♂ 2,2—2,5) zu sondern"; the former one would be found in the north, the latter in the south hemisphere. The total amount of variation for the length of the shell in the males would be 1,85—2,5 mm. This division is obviously incorrect; the male investigated by G. S. Brady and A. M. Norman, which was caught off the coast of Ireland, measured 2,55 mm., as has already been pointed out, i. e. more than G. W. Müller's southern specimens; in addition V. Vávra gives a length of 2,4—2,5 mm. for northern specimens; G. H. Fowler states 2,1 mm. The specimens investigated by me measured 2,3—2,6 mm. Length : height about 2 : 1. Length : breadth about 2,3 : 1. Seen from the side the shell has about the type reproduced by G. S. Brady and A. M. Norman; see the accompanying fig. 1. Seen from below it has its greatest width at about the middle and the anterior part is somewhat larger than the posterior part. The side contours are somewhat concave just behind the middle but apart from this they are uniformly curved. The anterior end is broadly rounded, with an almost symmetrical rostrum, the posterior end is somewhat pointed or rather narrowly rounded; cf. the accompanying fig. 2. The shoulder vault is rather well developed and well rounded. The surface of the shell is bare. Seen from inside: Selvage: This is either smooth-edged or finely serrulated on the rostrum and has no spines of any great size. It is smooth-edged along the anterior margin of the shell and the anterior half of the ventral margin; along the posterior half of the ventral margin of the shell it is finely serrulated and along the ventral half of the posterior margin of the shell it is coarsely and irregularly serrulated. The glands are of the type described by G. W. Müller. The medial glands along the posterior margin of the shell are rather large; most of them have a single exit; their exits are arranged in a rather distinct row running about half

way between the selvage and the margin of the shell or in most cases somewhat nearer the latter and (at least in the case of some of them) joined by a fine undulating line in about the way shown in my fig. 5 of *C. symmetrica*. Within the ventral part of the posterior margin of the shell, just dorsally of the left unsymmetrical gland, a number of these glandular exits are joined in about three groups; each of these groups of glands comprises from two to four glandular exits. These three groups are situated in line with the other glandular exits or often somewhat inside them. There is no distinctly developed hinge-socket or hinge-tooth at the posterior dorsal corner of the shell.

First antenna (fig. 3): — This is of the type described and reproduced by G. W. MÜLLER. The a-bristle is in most cases about as long as the second joint of this antenna. The pad of the b-bristle is of the same type and relative length as in *C. bispinosa*; see my fig. 3 of this species. The e-bristle has about 43—47 spines in each row; the distal 15—20 of these spines are situated in pairs, the others alternate more or less regularly; their shape seems to be the same as is reproduced by G. W. MÜLLER, pl. XVIII, fig. 7, 1906 a; there are no spines or bristles distally of these rows of spines. The anterior side of this bristle is almost quite bare; only one or a few short secondary bristles can be observed. All the joints are quite bare.

Second antenna: — Protopodite: In specimens with shells 2,4 mm. long this measured about 1,2 mm. Exopodite: The proportion between the length of this branch and that of the protopodite is about 10 : 18 or 1 : 2. The proportion between the length of the first joint and the total length of the eight following joints is about 10 : 4 or 10 : 5. The proportion between the length of the longest natatory bristles and that of this branch is about 3 : 2. The first joint is furnished with spines proximo-dorsally, but these are fewer than in *C. symmetrica* (cf. my fig. 12 of this species). Endopodite: This is of the type described and reproduced by G. W. MÜLLER. First joint: The processus mammillaris has a distal peg-like process. Third joint: The clasping organ on the right endopodite is in most cases not quite so strongly bent as in G. W. MÜLLER's pl. XVIII, fig. 10, 1906 a; cf. the accompanying fig. 4; this character varies, however, to some extent. The shaft of the h-bristle is usually furnished with short, fine spines; those of the i- and j-bristles are usually smooth.

Mandible: — Protopodite: Coxale: The toothed edge of the pars incisiva has about ten teeth. The distal tooth-list is of about the same relative size and type as has been described above for *C. oblonga*, though the number of teeth is on the average somewhat, though only slightly, greater than in the species mentioned. The proximal tooth-list is slightly narrower than the distal one, its teeth are rather irregular, often resembling more or less the type reproduced in my fig. 18 of *C. symmetrica*; on the inside it is furnished with small papillae situated close together. The masticatory pad is rather considerably narrower than the tooth-lists, about the same as in my fig. 15 of *C. symmetrica*, in most cases rather indistinctly divided into four or five transverse ridges and furnished with close small papillae. There is a low tooth just proximally of the masticatory pad. Basale: The six teeth on the distal edge of the endite have exceedingly fine serrulation. The single tooth on the outside of this endite is of about the same type and

relative size as in *C. elegans*. The e p i p o d i a l a p p e n d a g e is of about the same type and relative size as in *C. symmetrica*; cf. my fig. 21 of this species. E n d o p o d i t e: The first joint has four posterior bristles, all of them usually with short hairs. One of these, which is situated somewhat laterally, is often about as long as the anterior side of the first and second endopodite joints, the three others, situated somewhat medially, are relatively short, about half as long as the distal height of this joint or even somewhat shorter.

M a x i l l a: — The ventral edge of the end joint is about as long as the distal width of the first endopodite joint (calculating from front to back), its dorsal edge is about half as long.

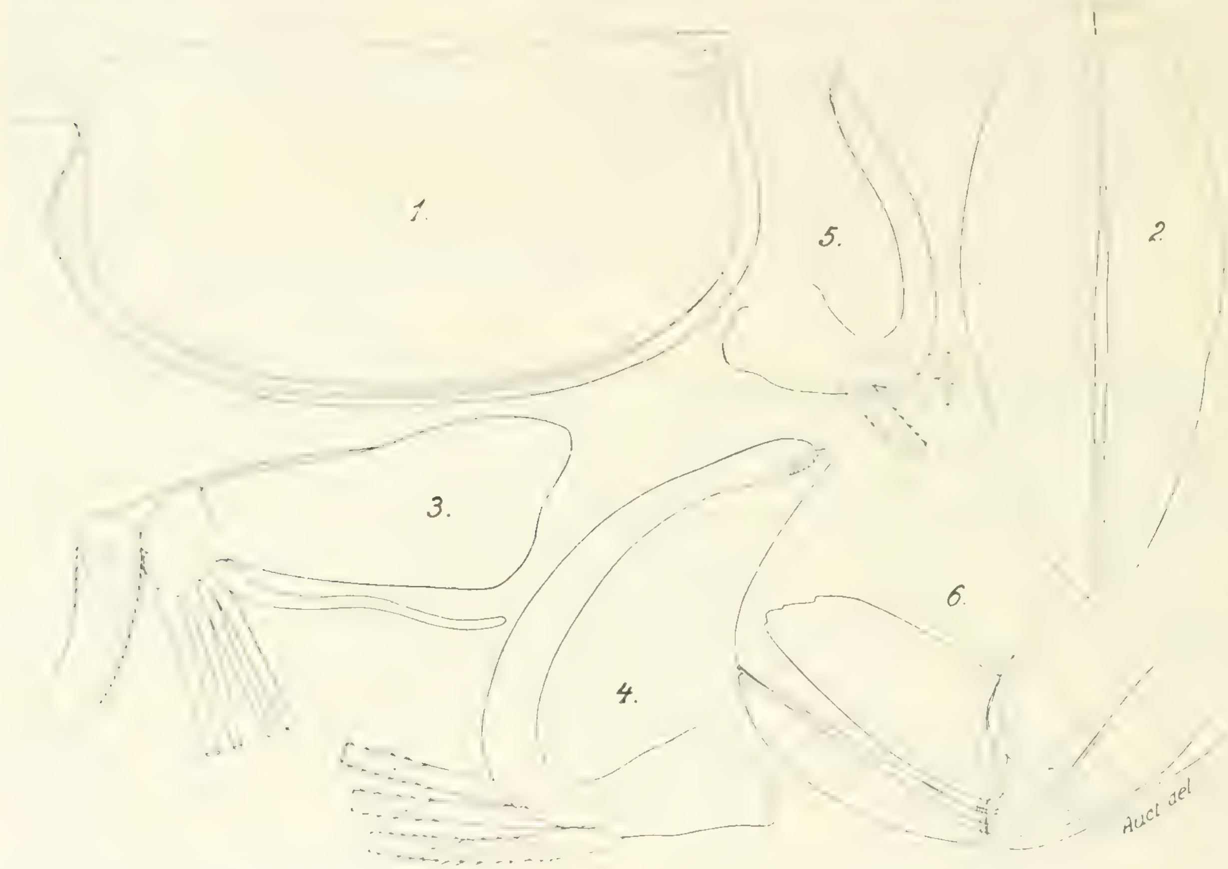

Fig. CXXVII. — *Conchoecia Haddoni* G. S. Brady and A. M. Norman, ♂. — 1. Shell seen from the side; 40 ×. 2. Shell seen from below; 34 ×. 3. Distal part of the first antenna and the rod-shaped organ; the b-, d- and e-bristles of the antenna are broken; 117 ×. 4. and 5. Distal joint of the endopodite of the right and left second antennae; the bristles are broken; 260 ×. 6. Distal part of the penis, seen from outside; 567 ×. (From specimens from station 64 b.)

F i f t h l i m b: — P r o t o p o d i t e: The longest tube-bristle of the second endite has short hairs. E n d o p o d i t e: This is of the same type as has been described above for *C. oblonga*. E x o p o d i t e: First joint: This has two, only in exceptional cases one, medial ventral bristles, both with short hairs. The proximo-ventral group has four or five bristles, one of which is in most cases furnished with long hairs. The distal ventral group has three or four bristles, all of which sometimes have short hairs, but sometimes one has long hairs. The

dorso-lateral bristle is furnished with long hairs. The bristles on this joint are of about the same relative length as in my fig. 27 of *C. symmetrica.* The dorsal bristle of the end joint is relatively somewhat shorter than in the figure just mentioned.

Sixth limb: — Exopodite: The bristles of the first joint are in most cases about the same as in my fig. 29 of *C. symmetrica* (the number of the ventral bristles is sometimes somewhat reduced?). The ventral bristle of the third joint is relatively long, often about as long as the height of this joint.

The end joint of the seventh limb is provided with spines.

Penis: — This has almost the same height along its whole length and is obliquely rounded distally. There are six rather broad oblique transverse muscles at the middle, distally of which there are no muscles. It has a well developed and moderately wide copulatory appendage of about the type reproduced in fig. 6.

Furca: — There is no unpaired bristle behind the claws.

Rod-shaped organ: — This is of the type described and reproduced by G. W. MÜLLER; cf. the accompanying fig. 3.

Upper lip: — The part between the combs on the postero-ventral edge of this lip is usually somewhat, though only rather slightly, more deeply notched in the middle than it is in my fig. 37 of *C. symmetrica.*

Female: —

Shell: — Length: According to G. S. BRADY and A. M. NORMAN, 3 mm.; G. W. MÜLLER, 1906 a, gives 2,2—2,95 mm. (cf. p. 668 above); G. H. FOWLER, 2,5—3 mm. The specimens measured by me were 2,7—3,2 mm. long. Seen from the side it is of about the type reproduced by G. W. MÜLLER. Seen from below it is of about the same type as in the male, but the posterior part of the shell is somewhat larger than in the latter and the anterior part somewhat smaller, in other words the anterior part of the shell dominates over the posterior part considerably less than in the male, sometimes the dominance is scarcely perceptible. In other respects it is like that of the male.

First antenna: — This is of the type reproduced by G. W. MÜLLER. The e-bristle has short hairs on the anterior side of its proximal third. The second joint has a moderate number of short, fine spines scattered proximally ventrally; the fourth joint, too, is armed with similar spines. Exceedingly fine spines of the same kind can also, at least in some cases, be observed at other places on this limb. I did not succeed in finding any yellow pigment corpuscles in this limb.

Second antenna: — Protopodite: In specimens with shells about 3 mm. long this measured about 1,2 mm. The exopodite is like that of the male. Endopodite: This has two joints: First joint: The processus mammillaris is like that of the male. Second joint: One of the c- and d-bristles is always developed; it has short hairs and is about as long as in pl. XVIII, fig. 8, G. W. MÜLLER, 1906 a; sometimes both of these bristles are developed, in which case one of them is always very short. The g-bristle is of about the same type and length as in the male (i. e. about as long as or somewhat longer than the protopodite). The f-bristle is about a third or a quarter shorter. The h-, i- and j-bristles are subequal, about

half as long as the g-bristle. The armature of the f-, g-, h-, i- and j-bristles is about the same as in the male; it varies to some extent. Between the h- and i-bristles there is a small papilla. Pilosity: The second endopodite joint is bare.

Sixth limb: — The ventral bristle on the end joint is most frequently somewhat relatively longer than in my fig. 30 of *C. symmetrica*.

The rod-shaped organ is of the type described by G. W. MÜLLER.

Remarks. — It is true that I found a number of differences between the specimens investigated by me and the original description of *C. Haddoni* as worked out by G. S. BRADY and A. M. NORMAN, but it seems to me extremely probable that my specimens belong to this species and that the deviations are due to the uncertainty of the original description. „Eine Nachuntersuchung dieser Individuen wäre dringend erwünscht, auch wegen der sicheren Identifizierung der Art“ (G. W. MÜLLER, 1906 a, p. 90).

Of the names included in the above list of synonyms *C. Haddoni*, P. T. CLEVE, 1905, G. W. MÜLLER, 1908 and C. H. OSTENFELD and C. WESENBERG-LUND, 1909 have no descriptions and identificatory figures. On account of the typical appearance of this species it seemed to me correct, however, to include them as synonyms. The other names are accompanied by verificatory information.

Habitat: — Atlantic Ocean:

S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth, 2500—0 m.; 23. VI. 1902: 10 mature males, 27 mature females and 3 juvenes; R. M. S. 254 and 255.

Distribution: — The Atlantic, between lat. 60° N. (V. VÁVRA) and lat. 40° S. (G. W. MÜLLER) and Indian Ocean (G. W. MÜLLER).

The specimens investigated by me were thus caught somewhat south of the previously established area of distribution.

Conchoecia bispinosa C. CLAUS.

Conchoecia bispinosa, C. CLAUS, 1890, p. 10.
„ „ „ „ 1891 a, p. 59; pl. V; pl. VI, fig. 1; pl. VIII, figs. 7, 8.
„ „ G. S. BRADY and A. M. NORMAN, 1896, p. 692 (= a reproduction of the original description).
„ „ P. T. CLEVE, 1900, p. 38.
„ „ (part?) G. W. MÜLLER, 1906 a, p. 90; pl. XVIII, figs. 12—19.
„ „ „ „ „ „ 1912, p. 79.

Description: — See C. CLAUS, 1891 a, p. 59.

Supplementary description: — Male:

S h e l l: — Length: According to C. CLAUS, 1,5—1,8 mm. (no difference in this character between male and female is given). The male investigated by me was 1,75 mm. long. Length: height about 2,2 : 1; length : breadth about 2,3 : 1. S e e n f r o m t h e s i d e it is of about the type reproduced by C. CLAUS; the posterior margin of the shell is perhaps not quite so straight. S e e n f r o m b e l o w it is of about the type described and reproduced above for *C. Haddoni*; the anterior part perhaps does not dominate quite so much over the posterior part as in the figure of the species mentioned. In other respects it resembles *C. Haddoni.*

F i r s t a n t e n n a: — This is of the same type as in *C. Haddoni* except that the e-bristle is furnished with only about 30—32 spines in each row; there are sparse short secondary bristles on the anterior side of this bristle.

S e c o n d a n t e n n a: — This is of quite the same type as is described and reproduced above for *C. Haddoni*; the clasping organ on the left endopodite was perhaps somewhat more rounded proximally in the specimen investigated by me than in my fig. 5 of the species just mentioned.

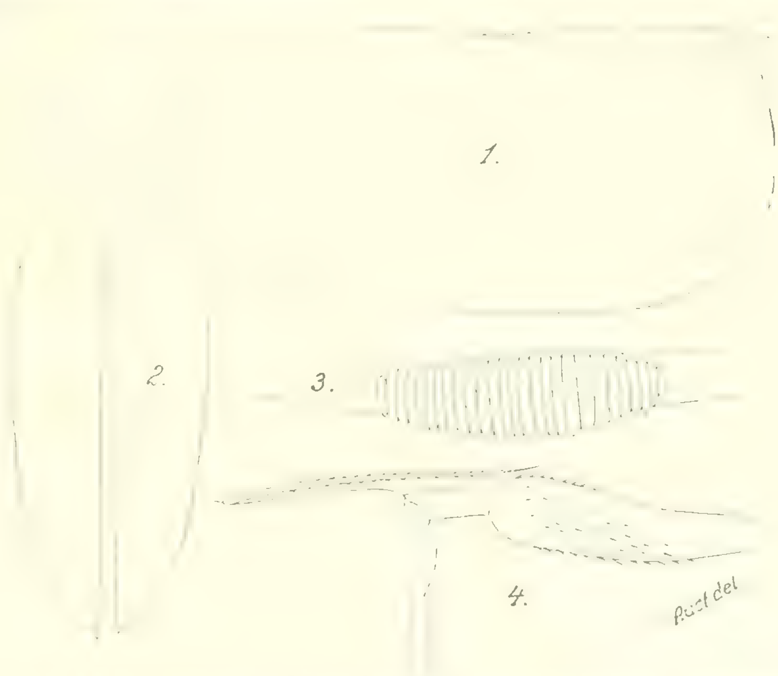

Fig. CXXVIII. — *Conchoecia bispinosa* C. CLAUS. — 1. Shell seen from the side, ♀; 50 ×. 2. Shell seen from below, ♀; 42 ×. 3. Pad on the b-bristle of the first antenna, ♂; 1200 ×. 4. Distal part of the rod-shaped organ and the first antenna, ♀; 187 ×. (Fig. 3 from a specimen from station 6 b, the other figures are from specimens from station 20 b.)

M a n d i b l e: — Of the same type as in *C. Haddoni*, but the number of teeth on the distal tooth-list is somewhat less (about the same as in my fig. 17 of *C. symmetrica*). The proximal tooth-list varies somewhat in type.

The m a x i l l a, the f i f t h, s i x t h and s e v e n t h l i m b s, the f u r c a, the r o d - s h a p e d o r g a n and the u p p e r l i p are of the same type as in *C. Haddoni.*

The p e n i s on the specimen investigated by me agreed well with the one reproduced by C. CLAUS, 1891 a, pl. V, fig. 4 (consequently also with this organ in *C. Haddoni*; the copulatory appendage is, however, not toothed at the edge as in my fig. 6 of the species in question).

F e m a l e: —

S h e l l: — Length: The specimens investigated by me measured 1,6—1,95 mm. Length : height about 2,2 : 1; length : breadth about 2,5 : 1. S e e n f r o m t h e s i d e (fig. 1) it is of the same type as that of the male, but the shoulder vault is somewhat less developed. S e e n f r o m b e l o w (fig. 2) it is about the same as in *C. Haddoni.* In other respects it is like that of the male.

The first antenna is of the same type as in *C. Haddoni*, but all the joints seem always to be bare.

In other respects it resembles *C. Haddoni*.

Remarks: — It seems to me beyond doubt that the form dealt with by me above is identical with *C. bispinosa* C. CLAUS. It is true that a number of small differences may be noted between the original description of this species and the specimens investigated by me, but these are presumably due to lack of accuracy on the part of C. CLAUS. It may be pointed out especially that in the females investigated by me the second joint of the first antenna was furnished with a dorsal bristle, while there is no such bristle in the figure of this organ given by C. CLAUS, 1891 a. To judge from C. CLAUS, pl. V, fig. 4 and pl. VIII, fig. 7 in the work mentioned the penis of this species would be subject to a considerable variation. In the male investigated by me this organ agreed, as has been pointed out above, with the first of these two figures. It is to be noted that C. CLAUS does not mention in the text that this organ is subject to variation. Did the penis reproduced in pl. VIII, fig. 7 belong to a specimen of another species than the one dealt with here?

As is seen above, C. CLAUS states that there was a moderately great variation in the length of the shell in this species (1.5—1.8 mm.). The specimens investigated by me also showed a relatively moderate variation with regard to this character; as is seen above, they resembled rather closely the specimens investigated by C. CLAUS (1.6—1.95 mm.). Contrary to this, G. W. MÜLLER points out (1906 a) that the length of the shell in this species is subject to very strong variation: „Größe außerordentlich schwankend: ♀ 1.74—3.0, ♂ 1,66—2.4 mm.“ This variation was, however, not continuous. We read as follows about it (1906 a, p. 91): „An manchen Fundorten sondern sich die Individuen deutlich in größere und kleinere, z. B. in Station 26 ♀ 1.74, 1.8, 2.5, 2.6 mm; 3 ♂ 1.66 mm, 2 ♂ 2.3 mm und derartige Funde legen den Gedanken nahe, daß wir es mit 2 Varietäten zu thun haben, doch finden sich zwischen den verschiedenen Größen alle Übergänge, auch einen Zusammenhang zwischen Größe und geographischer Verbreitung vermag ich nicht zu erkennen, ebensowenig wie zwischen Größe und der verschiedenen Beschaffenheit der Oberfläche, des Frontalorgans und der Greiforgane des ♂.“

Are we concerned here with a species whose shell shows a very great amplitude of variation with regard to length or has G. W. MÜLLER confused two very closely related varieties?

Apart from G. W. MÜLLER, V. VÁVRA is the only writer who has touched on this problem. In his work of 1906 this author distinguishes the larger specimens (♂ = 2,5 mm., ♀ = 2,8 mm.; no variation is stated in this work) as a new species, *C. secernenda**. With regard to the relation of this species to *C. bispinosa* V. VÁVRA writes (p. 60): „*Conchoecia secernenda* n. sp. steht *C. bispinosa* CLS. nahe, doch ist die Schalenform verschieden und um die Hälfte größer als diese. Die männliche Hauptborste trägt bei *C. secernenda* 45 Zähne, bei *C. bispinosa* 30 Zähne“. The difference in the shape of the shell between *C. bispinosa* and *C. secernenda* is rather slight. To judge from V. VÁVRA's fig. 121 the difference really seems to consist merely in the fact that the posterior part of the shell is somewhat higher in V. VÁVRA's new species; the posterior margin of the shell is also somewhat less straight in the latter form (in this the latter agrees with the

* There were no small specimens of *C. bispinosa* in the material investigated by V. VÁVRA.

specimens investigated by me). The differences in the length of the shell and the armature of the e-bristle on the male first antenna are, however, more important.

In his later works G. W. MÜLLER retains the view that he adopted in his work of 1906 a. In his synoptic work (1912) he thus writes *C. secernenda* as a synonym of *C. bispinosa*.

It is of course exceedingly difficult for me to have any decided views on this question, as I have only been able to investigate a rather small material of these forms. I have preliminarily sided with V. VÁVRA. The facts that led me to this decision were, first, the discontinuity of the variation in the length of the shell observed by G. W. MÜLLER at several localities and, secondly, the fact that in the male investigated by me the e-bristle on the first antenna was armed with about the same number of spines as C. CLAUS found in the specimens investigated by him.

Besides the places included in the list of synonyms worked out above *C. bispinosa* C. CLAUS is mentioned in the following places: G. S. BRADY, 1897, p. 95, P. T. CLEVE, 1905, p. 129 and G. W. MÜLLER, 1906 b and 1908. The reasons why I did not include these statements in the list just mentioned are, first, the uncertainty I have just pointed out and, secondly, the fact that there is no verificatory information about them.

C. bispinosa, P. T. CLEVE, 1900 is also without any verificatory information. I have nevertheless included it as a synonym because I have myself investigated the original material of this form; cf. below.

G. W. MÜLLER (1912) also includes *C. Mülleri*, CH. JUDAY, 1906 as a synonym of *C. bispinosa*. This identification is probably incorrect. Unfortunately, however, the original description of this species is too incomplete and uncertain to permit of any certain decision (length of shell, ♂ = 2,6 mm., ♀ = 2,8 mm.).

Relations to other species.

C. bispinosa is extremely closely related to *C. Haddoni*. The only characters that distinguish these two species are really, as is shown above, the occurrence of spines on the posterior dorsal corner of the shell in *C. bispinosa* and the armature of the e-bristle on the male first antenna. In the latter character the (large) specimens of *C. Haddoni* investigated by me resembled *C. secernenda*. Cf., in addition, the female antenna in the two forms. It would perhaps be most convenient to include *C. Haddoni* as a variety of *C. bispinosa*. That they are identical, i. e. that the differences mentioned are due to individual variation, seems to me rather improbable, especially because their areas of distribution do not quite coincide. Thus G. H. FOWLER found *C. Haddoni* in the Bay of Biscay, but not, on the other hand, *C. bispinosa*, in spite of the not inconsiderable material. V. VÁVRA found *C. Haddoni* at four stations „in vielen Exemplaren", *C. secernenda* at not less than twenty stations. In addition the two forms were never found together. Cf. also G. W. MÜLLER, 1906 a. It remains, however, a task for future investigators to examine this question in more detail.

Habitat: — Atlantic Ocean:

S. A. E., Pl. station 30, lat. 29° 52′ N., long. 20° 14′ W.; at the surface; 7. XI. 1901; temperature, 21°,1 C.: 1 male juvenis; R. M. S. 259. S. A. E., Pl. station 4 b, lat. 25° 51′ N., long. 21° 29′ W.; at the surface; 9. XI. 1901; temperature, 22.5° C.: 2 mature females; R. M.

S. 256. S. A. E., Pl. station 6 b, lat. 23° 35′ N., long. 22° 19′ W.; at the surface; 10. XI. 1901; temperature, 23.0° C.; 1 mature male. S. A. E., Pl. station 8 b, lat. 21° 51′ N., long. 23° ,0 W.; at the surface; 11. XI. 1901; temperature, 23.2° C.; 1 mature female; R. M. S. 257. S. A. E., Pl. station 20 b, lat. 11° 9′ S., long. 32° 55′ W.; at the surface; 29. XI. 1901; temperature, 26.4° C.; 2 mature females and 3 juvenes; R. M. S. 258.

Lat. 26° 15′ N., long. 20° 56′ W.*; VII. 1895; collector Chr. Levinsen: 1 mature female (defined by G. S. BRADY, 1902 a as *C. spinirostris*; see below p. 708). Stored in the collections of K. Z. M.

Lat. 42° 09′ N., long. 42° 15′ W.; 17. III. 1898: 1 male juvenis (length, 1,4 mm.); R. M. S. 383 (= P. T. CLEVE's material, 1900).

Distribution: — Atlantic Ocean from about lat. 42° N. (P. T. CLEVE, 1900) to lat. 32° N. (C. CLAUS, 1891 a).

All the stations of the Swedish "Antarctic" Expedition are consequently situated south of the distributional area of this species as stated by previous authors.

Gaussi group n.

Besides the species dealt with below, which has given the group its name, only *C. incisa* G. W. MÜLLER, out of the species of this genus hitherto described, seems to belong to this group. Unfortunately on account of the incompleteness of G. W. MÜLLER's description of *C. incisa* it is impossible as yet to make a detailed diagnosis of this group. The most striking character in this group is the occurrence of a large compound gland on both valves at about the middle of the ventral margin of the shell. There is no such gland in any of the other species so far known of this genus. There are no e- and d-bristles on the endopodite of the female second antenna.

G. W. MÜLLER in his work of 1906 a included *C. incisa* provisionally in the *Bispinosa* group. „Verwandt dürfte der Gruppe *C. incisa* sein, und mag diese Art hier ihren Platz finden." This writer was supported in this view by his investigation of *C. Gaussi*. He writes on this point (1908, p. 72): „Die Richtigkeit dieser Anschauung wird durch die Untersuchung von *C. Gaussi* bestätigt, da diese Form die für diese Gruppe charakteristischen Merkmale, Vergrößerung einiger medialer Drüsenzellen des Hinterrandes, auffällige Entwicklung einer lateralen Borste des zweiten Gliedes des Innenastes der zweiten Ant. zeigt, allerdings weniger auffällig als bei den typischen Formen. Am Hinterrand findet sich nur eine kleine Gruppe von Zellen, und diese Zellen scheinen nicht größer als die benachbarten . . . die längere laterale Borste ist nicht länger, sondern nur so lang wie das zugehörige Glied, aber immerhin länger als bei den anderen Arten der Gattung *Conchoecia*, auch ist sie viel länger als die neben ihr stehende. Man beachte auch die Bewaffnung der Nebenborsten der ersten Antn." The similarities pointed out by this writer are obviously not of a specially far-reaching nature. But it seems to me rather probable that *C. Gaussi* and *C. incisa* are fairly closely related to *C. bispinosa*. The

* Not 29° 56, W., as is stated by G. S. BRADY.

differences are, however, so many that the unity of the *Bispinosa* group would be weakened very essentially and its characterization rendered difficult, if these two forms were to be included in it. It seemed accordingly most convenient to distinguish them as a special group.

Conchoecia Gaussi G. W. Müller.

Conchoecia Gaussi, G. W. MÜLLER, 1908, p. 71; pl. IX, figs. 14—16; pl. X, figs. 9—12.
,, ,, ,, ,, ,, 1912, p. 80.

Description: — See G. W. MÜLLER, 1908, p. 71.

Supplementary description: — Female: —

Shell: — Length: 3,6 mm. Length : height about 2 : 1; length : breadth about 2,45 : 1. Seen from the side (see the accompanying fig. 1) it is of about the same type as that of the male. Seen from below (see the accompanying fig. 2) it has its greatest width at about or just in front of the middle and has the anterior part of the shell somewhat larger than the posterior part; the side contours are evenly curved, the anterior end is broadly rounded, the rostrum is symmetrical and the posterior end is pointed. The shoulder vault is only weakly developed and is rounded. The surface of the shell is bare; its sculpture agrees with that of the male. Seen from inside: Selvage: This is smooth-edged on the rostrum and has no spine-like process. Along the anterior margin and the anterior half of the ventral margin of the shell it is also smooth-edged. An exceedingly fine serrulation can be observed on the edge of the selvage at about the middle of the ventral margin; this serrulation increases somewhat, though only rather slightly, in strength along the posterior part of the ventral margin of the shell. Near the right unsymmetrical gland the serrulation is rather course and irregular. Dorsally of this gland the selvage is either irregularly scratched or else it is of the type reproduced in my fig. 4 of *C. symmetrica*, i. e. undulated and with a small lamelliform appendage in every hollow. The compound glands are like those described by G. W. MÜLLER for the male; there are no dorso-medial glands. With regard to the medial glands along the posterior margin of the shell in the male G. W. MÜLLER states that „die Mündungen . . . . sind durch flache Bogen verbunden, sie münden einzeln, abgesehen von einer kleinen Gruppe von drei Zellen, welche in der Nachbarschaft (dorsal von) der rechten unsymmetrischen Drüse liegt. Ihre Mündungen liegen außerhalb, der die Mündungen der anderen Zellen verbindenden Linie, welche hier etwas ausgelöscht ist." (A group of glandular openings of this sort was found by this writer only on one valve; the corresponding place on the other valve of the only specimen investigated was defective.) The same state of affairs was found by me in the female that I investigated, but with the difference that the group of glandular openings consisted of four, not three, openings and a similar group was found on both valves. There is no distinctly developed hinge-socket or hinge-tooth at the posterior dorsal corner of the shell.

First antenna (fig. 3): — The joints are rather well differentiated. The first joint is somewhat shorter than the second. The dorsal bristle of the second joint has short

hairs and is somewhat longer than the total length of the second and third joints. The e-bristle is not quite twice the length of this limb, is rather broadly sword-shaped distally and has short hairs proximally as well. The other bristles on the two end joints are not quite half as long as the e-bristle. All the joints are smooth.

Second antenna: — Protopodite: The length of this in the specimen investigated was 1.4—1.5 mm. Exopodite: The proportion between the length of this branch and that of the protopodite is about 10 : 6. The proportion between the length of the

Fig. CXXIX. — *Conchoecia Gaussi* G. W. Müller. — 1. Shell seen from the side; 24 ×. 2. Shell seen from below; 20 ×. 3. Left first antenna and the rod-shaped organ: the end bristles of the antenna are broken; 233 ×. 4. End joint of the endopodite of the second antenna seen from inside; the bristles are broken; 260 ×. 5. Distal part of the g-bristle of this joint; 160 ×. 6.—11. Mandible. 6. Toothed edge of the right pars incisiva seen from outside; 900 ×. 7. Right distal tooth-list seen from outside; 900 ×. 8. Right proximal tooth-list seen from outside; 900 ×. 9. The distal transverse ridge of the masticatory pad; 900 ×. 10. Distal part of the endite of the left basale seen from outside; 626 ×. 11. The proximo-medial ridge of the basale + the epipodial appendage; 567 ×. (From station 70 b.)

first joint and the total length of the eight following joints is about 10 : 4. The proportion between the length of the longest natatory bristles and that of the exopodite is about 7 : 5. The first joint is similar to that of *C. symmetrica*. Endopodite: This has two joints. First joint: The a- and b-bristles have short hairs, almost bare. Second joint (fig. 4): The proportion between the length of the g-bristle and that of the protopodite is about 3 : 4; this bristle has no distinct shaft and is rather broadly sword-shaped distally (cf. the accompanying fig. 5). The f-, h-, i- and j-bristles are subequal and about a quarter or a fifth shorter than the g-bristle; they all have rather well developed shafts and are not sword-shaped distally. The g-, f-, h-, i- and j-bristles have short hairs proximally; the four latter ones are quite or almost quite bare distally; the g-bristle has short hairs along one edge. There are no c- and d-bristles. Between the h- and i-bristles there is an exceedingly small papilla. Pilosity: The second endopodite joint is bare.

Mandible: — Protopodite: The toothed edge of the pars incisiva is of a type rather different from the rest of this genus (see the accompanying fig. 6). Its anterior tooth is of about the same type and relative size as in (all?) the other species of this genus. Behind this tooth there follows a series of (somewhat more than twenty) smooth triangular teeth, of which the anterior ones (about five) are moderately large and strong, the others decreasing in size and strength the more posteriorly they are situated; the posterior ones form a fine serrulation. This edge ends posteriorly with a powerful, low, wide, irregularly rounded, smooth tooth. Distal tooth-list (see the accompanying fig. 7): This is somewhat narrower than the toothed edge; it has a large, powerful, smooth, fang-like posterior tooth and a single row of about fifteen to seventeen simple, smooth, pointed, moderately large teeth which vary somewhat in size. Proximal tooth-list (see the accompanying fig. 8): This is somewhat narrower than the distal tooth-list. It has a relatively small and somewhat varying number of smooth, pointed teeth, of which the posterior one is of about the same type and strength as the posterior tooth on the distal tooth-list, the others decreasing irregularly in size and strength, the anterior ones being quite small (on both the mandibles in the specimen investigated they were about the same type as in the accompanying figure). The masticatory pad is rather high, divided into four thin plates placed transversally, the distal one of which is somewhat narrower than the proximal tooth-list, the others decreasing somewhat in width the more proximally they are situated; the free edges of these plates are deeply and irregularly toothed (cf. the accompanying fig. 9). The part of the pars incisiva that is surrounded by lancet-bristles and hairs is somewhat raised and is furnished with dense papillae and short, fine hairs. Basale: This has the same number of teeth on the distal edge of the endite as in the other species of this genus investigated by me; the difference between main teeth and secondary teeth has, however, almost vanished (the former are considerably weaker, the latter considerably stronger, than in the majority of the species of this genus), so that this edge seems rather finely and evenly serrulated (cf. the accompanying fig. 10). The single tooth on the outside of this process is somewhat wider than each of the (six) distal teeth and is quite or almost quite smooth. The two appendages on the posterior edge of this endite are furnished with unusually strong secondary spines. The disto-medial bristle on this joint is relatively long and has long hairs. The epipodial appendage is

rather small and has a rather small bristle with a thick base (see the accompanying fig. 11). Endopodite: The first joint has four short-haired bristles on the posterior side; these are of about the same relative lengths as in my fig. 22 of *C. symmetrica.* The antero-distal bristle on this joint has short hairs and is not inconsiderably longer than the second endopodite joint.

Maxilla: — Protopodite: Endite on the procoxale: The three postero-outer tube-bristles and the pointed bristle situated close to them are furnished with a few moderately long secondary bristles. The four other single-pointed bristles are furnished with rather long spines. the two anterior inner ones (like the anterior inner tube-bristle) have rather long secondary bristles as well. (The difference between „secondary bristles" and „spines" is of course not a fundamental one, but only one of degree; the „spines" are more or less stronger than the „secondary bristles".) Endite on the coxale: There are only three, not, as is usual in this genus, four tube-bristles on the posterior process. Endopodite: First joint: On one maxilla in the specimen investigated by me there were three bristles on the posterior edge (as is usual in this genus), on the other there were four. The end joint is relatively short and of about the same type as in my fig. 9 of *C. serrulata.*

Fifth limb: — Protopodite: The longer of the two tube-bristles on the second endite has short hairs. Endopodite: This is of the same type as has been described for *C. oblonga* (see my fig. 27 of *C. symmetrica*). Exopodite: First joint: This has one or two medio-ventral short-haired bristles, three proximo-ventral bristles, the two longest of which are furnished with rather long secondary bristles, the third having short hairs, two disto-ventral bristles, one of which is furnished with rather long secondary bristles. The dorso-lateral bristle on this joint is furnished with rather long secondary bristles. All the bristles on this joint are of about the same relative length as in my fig. 27 of *C. symmetrica.* Of the bristles on the end joint the dorsal one and the ventral one are subequal, somewhat more than half the length of the middle one. Pilosity: The protopodite and the first exopodite joint are partly furnished with long hairs.

Sixth limb: — Exopodite: First joint: The dorso-distal bristle is relatively somewhat longer, the dorso-lateral bristle relatively somewhat shorter than in my fig. 30 of *C. symmetrica.* On one limb one of the three ventero-distal bristles of this joint had short hairs in the specimen investigated by me.

Seventh limb: — The end joint is furnished with spines.

Furca: — Behind the claws there is no unpaired bristle.

Rod-shaped organ: — This is of the same type as in *C. Haddoni* and *C. bispinosa*; cf. the accompanying fig. 3.

Upper lip: — This is of about the same type as in the two species just mentioned, but the part between the combs is perhaps somewhat more deeply notched (not so much, however, as in my fig. 15 of *C. rotundata*) and the teeth of the combs are somewhat coarser. The paragnates are similar to those of the species just mentioned.

[illegible] *Remark:* — It seems to me extremely probable that the female described above really belongs to this species, partly because of the great similarity that is shown in the type and size

of the shell and partly because it was caught in a region which, from the point of view of its plankton-fauna, presumably agrees very closely with that from which the male described by G. W. MÜLLER came. Of course this identification is not quite certain.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 70 b, lat. 49° 56′ S., long. 49° 56′ W.; depth, 2700—0 m.; 27. VI. 1902; temperature at 2700 m. and at the surface, + 1.67° C. and 3.49° C. resp.: 1 mature female. On slides in the collections of R. M. S.

Distribution: — A single male was captured by the „Gauss" at lat. 35° S. and long. 2° E.

Serrulata group n.

(*Pseudoconchoecia* C. CLAUS)

Of the species of this genus hitherto described the one dealt with below seems to be the only one that can be referred with entire certainty to this group.

C. serrulata was provisionally placed by G. W. MÜLLER, 1906 a, in the *Loricata* group. As far as I can see, this assignment was based practically exclusively on the agreement with regard to the positions of the compound glands. To this character, however, no great systematic importance is to be attached, as the positions of these glands do not differ more or less decidedly from what is the case in most of the other species of this genus, but are, on the contrary, very near to what one might call the normal for this genus. (Cf., for instance, *C. rhynchena* G. W. MÜLLER and *C. plinthina* G. W. MÜLLER, etc.) On the other hand the differences between *C. serrulata* and *C. loricata* C. CLAUS — *C. ctenophora* G. W. MÜLLER, the two species that form the *Loricata* group, are not inconsiderable. By including *C. serrulata* in the *Loricata* group the systematic unity of this group is lessened to a very great extent. It seemed to me accordingly inconvenient to follow this procedure of G. W. MÜLLER's and so I have distinguished *C. serrulata* as a representative of a special group.

Whether *C. concentrica* G. W. MÜLLER is closely related to *C. serrulata* I cannot say. It does not seem to me impossible. G. W. MÜLLER writes as follows with regard to this species (1906 b, p. 11): „Ich vermag keine deutlichen verwandtschaftlichen Beziehungen zu einer der bekannten Arten zu erkennen; manche Charactere sprechen für eine Verwandtschaft mit *C. serrulata.*"

Conchoecia serrulata C. CLAUS.

Conchoecia serrulata, C. CLAUS, 1874 a, p. 176.

„ „ „ „ 1874 b, p. 6; pl. I, figs. 2—7, 9, 10; pl. II, figs. 12, 13, 17, 19.

Halocypris atlantica, G. S. BRADY, 1880, p. 164; pl. XL; pl. XLI, figs. 11, 12.

Pseudoconchoecia serrulata, C. CLAUS, 1890, p. 20.

Pseudoconchoecia serrulata, C. CLAUS, 1891 a, p. 72; pl. XIX; pl. XXIII, figs. 1—13.
,, ,, G. S. BRADY, 1897, p. 96; pl. XVII, figs. 22—24.
Conchoecia ,, G. W. MÜLLER, 1906 a, p. 97; pl. XXII, fig. 24; pl. XXIII, figs. 20—33.
Pseudoconchoecia ,, var. *laevis*, G. S. BRADY, 1907, p. 2.
Conchoecia ,, G. W. MÜLLER, 1908, p. 73.
,, ,, (*serrulata* + *laevis*), G. W. MÜLLER, 1912, pp. 81 and 82.

Description: — See C. CLAUS 1891 a, p. 72 and G. W. MÜLLER, 1906 a, p. 97.

Supplementary description: — Male: —

Shell: — Length: C. CLAUS states this as 1,4—1,6 mm. (no difference between males and females). According to G. W. MÜLLER it is 1,25—1,4 mm. „die des Indischen Oceans deutlich kleiner". The specimens investigated by me measured 1,05—1,4 mm. Length : height about 1,6 : 1; length : breadth about 1,7 : 1. Seen from the side it is of about the type reproduced by C. CLAUS, 1891 a, pl. XIX, fig. 1 (see the accompanying fig. 1), i. e. it has a somewhat less arched ventral margin than in G. W. MÜLLER'S pl. XXII, fig. 24, 1906 a. Seen from below its greatest width is at about the middle, and, owing to its shoulder vault being very powerfully developed, the anterior part of the shell is somewhat larger than the posterior part. Owing to the powerful development of the shoulder vault a sinuation is produced somewhat behind the middle; apart from this the side contours are evenly curved. The anterior end is rather broadly rounded and has a symmetrical rostrum, the posterior end is also rounded or somewhat pointed; cf. the accompanying fig. 2. As has already been pointed out, the shoulder vault is very powerfully developed, but well rounded. The surface: The sculpture varies, sometimes being rather powerfully developed, of about the type described by G. W. MÜLLER, sometimes more or less weak, the striation having more or less completely disappeared just as „the marginal serrulations"; specimens with reduced shell-sculpture have so far been found only in the Antarctic; cf. p. 686 below. The surface of the shell has no hairs. Seen from inside: Selvage: This is smooth-edged on the rostrum and along the anterior margin of the shell and the anterior half of the ventral margin of the shell; it has no spine-like process on the rostrum. It is finely serrulated along the posterior half of the ventral margin of the shell and the posterior margin of the shell. The compound glands are of the type described by G. W. MÜLLER. The glands along the posterior margin of the shell are comparatively weakly developed; their exits are of about the type described above for *C. oblonga*. There is a rather well developed oval hinge-socket and hinge-tooth at the posterior dorsal corner of the shell.

First antenna (fig. 3): — This is of about the type described and reproduced by G. W. MÜLLER. The retinaculum of the second joint was bare in the specimens investigated by me; in G. W. MÜLLER'S pl. XXIII, fig. 22 this bristle has short hairs. According to G. W. MÜLLER the „Nebenborsten" are „nicht behaart"; in the specimens investigated by me these bristles were furnished with a larger or smaller number of short, fine, distally pointing hairs about opposite to the distal part of the row of spines on the e-bristle; these hairs were

always more numerous on the b-bristle than on the d-bristle. On the anterior side of the e-bristle there are sparse short distally pointing hairs, the distal ones of which (at the row of spines) are somewhat more powerful than the proximal ones. These three bristles have no pad-like formations. The a-bristle is somewhat shorter than the second joint of this antenna. All the joints are quite bare.

Second antenna: — Protopodite: In specimens whose shells were about 1.35 mm. long this part was about 0.7 mm. long. Exopodite: The proportion between the length of this branch and that of the protopodite is about 11 : 20. The proportion between the length of its first joint and the total length of the eight following joints is about 10 : 4. The proportion between the length of the longest natatory bristles and that of this branch is about 3 : 2. The first joint is very wide and flattened (cf. the accompanying fig. 4) and, as far as I can see, quite bare. Endopodite: This is of the type described and reproduced by G. W. MÜLLER; see figs. 5 and 6. The a- and b-bristles have short hairs. The e-bristle is developed, but is very short. The g-bristle is about as long as or somewhat shorter than the protopodite. The h-, i- and j-bristles are very narrow, only about half the proximal width of the f-bristle or still narrower.

Mandible: — Protopodite: Coxale: The toothed edge of the pars incisiva has from about seven to ten teeth, the posterior one of which is rather powerful; cf. the accompanying fig. 7. The distal tooth-list is of about the same type and relative size as has been described for *C. oblonga* above. The proximal tooth-list is rather slightly narrower than the distal one, but otherwise it varies rather considerably in type. In his diagnosis of the genus *Pseudoconchoecia* C. CLAUS states (1891 a, p. 71) that „die distale Zahnleiste beginnt mit zwei, die proximale mit nur einem Zahn". The first part of this statement is quite correct; the incorrectness of the second part is best shown by the accompanying fig. 8, which shows one of the many types that this tooth-list had in the specimens investigated by me. The masticatory pad is not inconsiderably narrower than the tooth-lists; it is divided into four or five transverse ridges, which are separated by moderately deep grooves, and is armed with fine papillae situated close together. The part near the lancet-bristles and row of hairs is rather weakly pad-shaped and is furnished with a number of papillae. Basale: This is relatively short, about the same as in pl. XIX, fig. 10, C. CLAUS, 1891 a. The six teeth on the distal edge of the endite are furnished with very fine serrulation. The single tooth on the outside of this process is of about the type described for *C. elegans* above. The epipodial appendage is represented by a rather short bristle. Endopodite: The first joint has four short-haired bristles on the posterior side, one of which is situated somewhat laterally and is about as long as the anterior side of the first and second endopodite joints; the three others, which are situated somewhat medially, are rather short, sometimes even very short. The anterior distal bristles of the second joint are relatively somewhat longer than in my fig. 22 of *C. symmetrica*.

Maxilla: — Endopodite: First joint: One or more of the bristles on the anterior edge of this joint are furnished at the middle with rather long secondary bristles, and similar bristles are also found on one of or often even on all the bristles on the posterior edge of this joint. The end joint is moderately long, its ventral edge is somewhat longer than the width of this joint

(calculating from front to back), its dorsal edge is about half as long; see the accompanying fig. 9.

Fifth limb: Protopodite: The longer of the two tube-bristles on the second endite has short hairs. The endopodite is similar to that in *C. oblonga* (see my

Fig. CXXX. — *Conchoecia serrulata* C. CLAUS. — 1. Shell seen from the side, ♂; 66 ×. 2. Shell seen from below, ♂; 60 ×. 3. Distal part of the left first antenna and the rod-shaped organ; the b-, d- and e-bristles of the antenna are broken, ♂; 213 ×. 4. Exopodite of the right sec nd antenna seen from outside, all the long bristles are broken, ♂; 260 ×. 5. Endopodite of the right second antenna seen from inside, f- and g-bristles broken, ♂: 400 ×. 6. Distal part of the endopodite of the left second antenna seen from inside; the f-, g-, h-, i- and j-bristles are broken, ♂; 400 ×. 7. The toothed edge of the pars incisiva of the left mandible seen from inside, ♀; 833 ×. 8. The proximal tooth-list of the right mandible seen from inside, ♀; 1200 ×. 9. Distal part of the endopodite of the left maxilla seen from inside, ♂; 567 ×. (Figs. 7 and 8 from a specimen from station 314, all the others from specimens from st. 64 b.)

fig. 27 of *C. symmetrica*). The exopodite is the same as in this figure. The protopodite and the first exopodite joint are partly furnished with long hairs.

Sixth limb: This is about the same as in my fig. 29 of *C. symmetrica*, but, as is the case in most of the other species of this genus, the ventral bristle on the end joint is furnished with long secondary bristles.

The end joint of the seventh limb has spines.

Penis: — This is of about the same type as in my fig. 32 of *C. symmetrica*, only being perhaps somewhat less elongated. At about the middle it is furnished with about six oblique transverse muscles, distally of which there are no muscles. The copulatory appendage is rather narrow, resembling in shape the type reproduced for *C. Haddoni*, but without serrulation.

Furca: — Behind the claws there is an unpaired, moderately long, long-haired bristle, of about the type shown in pl. XIX, fig. 14, C. CLAUS, 1891 a.

Rod-shaped organ: — The shaft reaches to about the proximal boundary of the third joint of the first antenna or somewhat farther. The capitulum is of about the type reproduced by G. W. MÜLLER (see the accompanying fig. 3) and is not quite so long as the second joint of the first antenna.

Upper lip: — The part between the combs on the posterior ventral edge of this lip is of about the type reproduced by me in my fig. 4 of *C. Belgicae*. The paragnates are about the same as in *C. symmetrica*.

Female:

Shell: — Length: According to G. W. MÜLLER, 1,6—1,7 mm.; two females from the Indian Ocean that were investigated by this writer measured only 1.4 mm.; cf. p. 682 above. The lengths of the specimens investigated by me varied between 1,2 and 1,65 mm. Seen from the side the shell is of about the type reproduced by C. CLAUS, 1891 a, pl. XIX, fig. 2, consequently somewhat more elongated than in the male. Seen from below it is of about the type reproduced in fig. 3 of the plate just mentioned, i. e. with its shoulder vault less strongly developed. In other respects it is about the same as in the male.

First antenna: — This is of the type reproduced by C. CLAUS, 1891 a, pl. XIX, fig. 6, but has a well developed dorsal bristle on the second joint; this bristle has short hairs and is almost as long as the second joint. The e-bristle, which is not widened and sword-shaped distally, has on the anterior side of the proximal half a moderate number of rather short hairs. The second joint is partly furnished with short hairs; the distal part of this limb is furnished more or less abundantly with rather short hairs.

Second antenna: — The protopodite is somewhat weaker than in the male. The proportions of the exopodite are about the same as in the male. Endopodite: This has three joints; the third joint is, however, extremely small; cf. G. W. MÜLLER, 1906 a, p. 98. The bristles on the first joint are the same as the male. Second joint: The g-bristle is either of about the same type and relative length as in the male or else it is slightly shorter. The f-bristle is about a quarter or a fifth shorter than the g-bristle and is also of the same type as in the male. The c- and d-bristles are often quite absent, sometimes one of them is developed; see G. W. MÜLLER, 1906 a, pl. XXIII, fig. 33. Third joint: The h-, i- and j-bristles are of some-

what different lengths, from a sixth to a third shorter than the f-bristle and almost as thick as this (these three bristles are thus considerably more developed than in the male), bare and without shafts. Between the h- and i-bristles there is, at least in some cases, an exceedingly small papilla. Pilosity: The second endopodite joint is furnished with moderately long, fine hairs; see pl. XXIII, fig. 33, G. W. MÜLLER, 1906 a.

Sixth limb: — One of the two bristles on the endopodite has short hairs.

Remarks. — It seems to be quite certain that the species dealt with above is identical with *C. serrulata*, C. CLAUS, 1874. It is true that the original description of C. CLAUS's species is not complete and also in some details obviously incorrect (e. g. in the number of bristles on the male first antenna; see this writer, 1874 b, pl. I, fig. 7), but, in spite of this, it may be said to be sufficient for a quite certain identification on account of the type of this species, which is in several respects characteristic.

C. CLAUS in his work of 1890, p. 21 identified *Halocypris atlantica*, G. S. BRADY, 1880 with this species. This identification is based chiefly on the shell; most of the other organs are certainly described and reproduced by G. S. BRADY, but the descriptions and figures are unfortunately so uncertain and incorrect that no regard can be paid to them. In spite of this it may be said that the correctness of this identification is beyond doubt. It has also been adopted both by G. S. BRADY himself and by G. W. MÜLLER. (The latter added a query, however, in his latest work, 1912.) An important reservation must, however, be made with regard to this identification. The uncertainty of G. S. BRADY's determinations is such that it is best not to accept the information as to the localities of this species that is given by this writer. The following is a good illustration of this uncertainty. In his work of 1880 it is stated that this species was caught by the „Challenger" Expedition at twelve stations scattered over the Atlantic and Pacific Oceans. According to the same writer's work of 1897, p. 97, this expedition caught this species at only four stations; only two of these stations are the same as those given in 1880.

In his work of 1907 G. S. BRADY states that *C. serrulata* was caught by the „Discovery" at some stations in the Antarctic Ocean. With regard to these specimens it is stated that they „differed in all cases from the type in being almost destitute of colour and striation of the shell, and in the absence of marginal serrulations". In all other respects, however, they seemed to agree with the type species. On account of these deviations G. S. BRADY distinguished these specimens as the representatives of a special variety, which he called *laevis*. — These differences caused G. W. MÜLLER, 1908, to doubt the correctness of this identification of G. S. BRADY's, „einigen Zweifel an der Richtigkeit der Identifizierung nicht unberechtigt erscheinen". Both forms (*C. serrulata serrulata* and *C. serrulata laevis*) are, however, included in this writer's synoptic work of 1912. It is certainly not impossible that the specimens defined by G. S. BRADY as *C. serrulata laevis* belong to quite a different species, but there seems to me to be no special reasons to doubt the correctness of the identification. As has been pointed out above in the supplementary description worked out by me, the shell-sculpture in this species is subject to considerable variation. A good illustration of this is found in G. W. MÜLLER's description of

this species (1906 a). The specimens investigated by me also varied with regard to the strength of their sculpture; in a number of them the sculpture was rather strong, in others, on the contrary, it was more or less weak; I never, however, found it quite so weak as is stated by G. S. BRADY, but it does not seem to me impossible that specimens which live at a very low temperature might be more or less entirely destitude of sculpture (cf. *C. borealis-maxima*). The distinguishing feature of the variation found by me was that it was continuous. Because of this it seemed to me best not to retain the form *laevis* as a special variety, but in the list of synonyms given above I have included it as a synonym of the type species.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth, 2500—0 m.; 23. VI. 1902; temperature at the surface, 7,9° C.: 325 mature specimens and 20 juvenes; proportion between males and females about 3 : 5; R. M. S. 264 and 265. S. A. E., Pl. station 65 b, at the same locality; depth, 400—0 m.; 23. VI. 1902; temperature at 400 m., 3,95° C.: 2 mature males and 9 mature females; R. M. S. 267. S. A. E., Pl. station 66 b, at the same locality; depth, 200—0 m.; 23. VI. 1902; temperature at 200 m., 5,25° C.: 8 mature males, 6 mature females and 1 juvenis; R. M. S. 268. S. A. E., Pl. station 67 b, at the same locality; depth 100—0 m.; 23. VI. 1902; temperature at 100 m., 8,3° C.: 14 mature males, 12 mature females and 1 juvenis; R. M. S. 269. S A. E., Pl. station 68 b, at the same locality; depth 50—0 m.; 23. VI. 1902; temperature at 50 m., 7,55° C.: 4 mature males and 1 mature female; R. M. S. 270. S. A. E., Pl. station 345, lat. 48° 32′ S., long. 44° 28′ W.; at the surface; 24. VI. 1902; temperature, 7,9° C.: 1 mature female; R. M. S. 291. S. A. E., Pl. station 347, lat. 49° 3′ S., long. 46° 54′ W.; at the surface; 25. VI. 1902; temperature, 4,5° C.: 6 juvenes. S. A. E., Pl. station 70 b, lat. 49° 56′ S., long. 49° 56′ W.; depth 2700—0 m.; 27. VI. 1902; temperature at 2700 m. and at the surface, ÷ 1,67° C. and 3,4° C. resp.: 2 mature females; R. M. S 272. At the same station; depth 500—0 m.: 1 mature female and 4 juvenes; R. M. S. 271. S. A. E., Pl. station 357, lat. 51° 31′ S., long. 54° 39′ W.; at the surface; 1. VII. 1902; temperature, 5,0° C.: 1 mature female and 2 juvenes; R. M. S. 293. S. A. E., Pl. station 355, lat. 51° 34′ S., long. 53° 18′ W.; at the surface; 30. VI. 1902; temperature, 4,5° C.: 3 mature females and 5 juvenes; R. M. S. 292. S. A. E., Pl. station 302, lat. 52° 6′ S., long. 55° 32′ W.; depth 500—0 m.; 12. IV. 1902; temperature at 500 m. and at the surface, 3,78° C. and 6,28° C. resp.: 6 mature males, 3 mature females and 2 juvenes; R. M. S. 279. S. A. E., Pl. station 301, at the same locality; depth 100—0 m.; 12. IV. 1902; temperature at 100 m., 5,78° C.: 10 mature males, 12 mature females and 9 juvenes; R. M. S. 278. S. A. E., Pl. station 300, at the same locality; depth 50—0 m.; 12. IV. 1902; temperature at 50 m., 6,21° C.: 6 mature males, 4 mature females and 2 juvenes; R. M. S. 276 and 277. S. A. E., Pl. station 298, at the same locality; at the surface; 12. IV. 1902: 1 mature male and 14 mature females; R. M. S. 275. S. A. E., Pl. station 60 b, lat. 52° 39′ S., long 37° 35′ W.; depth 500—0 m.; 17. VI. 1902; temperature at 500 m. and at the surface, + 1,35° C. and + 0,50° C. resp.: 1 mature female; R. M. S. 263. S. A. E., Pl. station 307, lat. 52° 55′ S., long. 53° 12′ W.; at the surface; 14. IV. 1902; temperature, 6,1° C.: 1 mature male, 4 mature females and 1 juvenis; R. M. S. 280. S. A. E., Pl. stations 59 b and 318, lat. 53° 0′ S., long.

48° 27′ W.; depth 500–0 m.; 17. IV. 1902; temperature at 500 m. and at the surface, +1,50° C. and 3,40° C.: 10 mature males, 62 mature females and 2 juvenes; R. M. S. 262 and 288. S. A. E., Pl. stations 58 b and 317, at the same locality; depth 250–0 m.; 17. IV. 1902; temperature at 250 m., 1,30° C.: 91 mature males, 173 mature females and 9 juvenes; R. M. S. 261 and 287. S. A. E., Pl. stations 57 b and 316, at the same locality; depth 100–0 m.; 17. IV. 1902; temperature at 100 m., 3° C.: 39 mature males and 93 mature females; R. M. S. 260 and 286. S. A. E., Pl. stations 56 b and 315, at the same locality; depth 50–0 m.; 17. IV. 1902; temperature at 50 m., 3,35° C.: 52 mature males and 138 mature females; R. M. S. 266 and 285. S. A. E., Pl. station 314, at the same locality; at the surface; 17. IV. 1902: 29 mature males, 216 mature females and 1 juvenis; R. M. S. 284. S. A. E., Pl. station 312, lat. 53° 1′ S., long. 51° 53′ W.; depth 200–0 m.; 15. IV. 1902; temperature at 200 m. and at the surface, 3,50° C. and 5,48° C. resp.: 3 mature males, 4 mature females and 1 juvenis; R. M. S. 282. S. A. E., Pl. station 311, at the same locality; depth 70–0 m.; 15. IV. 1902; temperature at 70 m., 5,25° C.: 3 mature females and 1 juvenis; R. M. S. 281. S. A. E., Pl. station 319, lat. 53° 13′ S., long. 47° 0′ W.; at the surface; 18. IV. 1902; temperature, 3,31° C.: 2 mature females; R. M. S. 289. S. A. E., Pl. station 291, lat. 53° 15′ S., long. 60° 53′ W.; at the surface; 25. III. 1902; temperature, 8,2° C.: 2 mature males and 2 mature females; R. M. S. 274. S. A. E., Pl. station 320, lat. 53° 29′ S., long. 45° 23′ W., at the surface; 18. IV. 1902; temperature, 3,67° C.: 1 mature female and 1 juvenis; R. M. S. 290. S. A. E., Pl. station 279, lat. 55° 15′ S., long. 65° 17′ W.; at the surface; 3. III. 1902; temperature, 8,6° C.: 7 juvenes of different stages; R. M. S. 273. S. A. E., Pl. station 214, lat. 57° 9′ S., long. 60° 28′ W.; at the surface; 7. I. 1902; temperature, 6,0° C.: 1 mature male, 1 mature female and 1 juvenis; R. M. S. 283.

Distribution: — According to C. CLAUS, 1874 b: „Atlantischer Ocean. Küste von Chile." This writer does not specify the localities of the finds in the Atlantic. According to G. W. MÜLLER, 1906 a and 1908, it is found in the Atlantic between lat. 10° S. and lat. 58° S. and in the Indian Ocean. G. S. BRADY, 1907, found it in the Antarctic as far south as lat. 59° S.

The specimens investigated by me were caught within the previously known area of distribution.

Magna group G. W. MÜLLER.

(= *Conchoecia* [part.] C. CLAUS).

As G. W. MÜLLER pointed out, 1906 a, p. 99, this group cannot be defined and characterized quite sharply. To judge, however, from the descriptions of species belonging to it that are found in the literature, we are nevertheless probably concerned with a quite natural unit. The only doubt expressed by G. W. MÜLLER in the work just mentioned was as to the relationship

of the species dealt with below, *C. spinirostris*, to the other species of this group. With regard to this cf. p. 616 above.

Besides the forms included by G. W. MÜLLER the species *C. zetesios*, established by G. H. FOWLER, 1909, also belongs to this group. This species cannot, however, be retained; as I hope to be able to show in a following work, we are only concerned here with non-mature individuals of *C. macrocheira* G. W. MÜLLER.

Conchoecia lophura G. W. MÜLLER

Conchoecia lophura, G. W. MÜLLER, 1906 a, p. 99; pl. XX, figs. 1—10.
.. .. ,, ,, ,, 1906 b, p. 6.
.. .. ,, ,, ,, 1908, p. 73.
.. *hyalophyllum* (part.), G. H. FOWLER, 1909, pp. 236, 265; pl. XIX, figs. 90 to 92, 102; pl. XX, figs. 103, 104.
.. *lophura*, G. W. MÜLLER, 1912, p. 82.

Description: — See G. W. MÜLLER, 1906 a, p. 99.

Supplementary description: — Male:

Shell: — Length: According to G. W. MÜLLER 2,2—2,8 mm. The specimen investigated by me measured 2,65 mm. Length : height about 1,9 : 1; length : breadth about 2,1 : 1. Seen from the side it is of about the type described and reproduced by G. W. MÜLLER; cf. the accompanying fig. 1. Seen from below it has its greatest width at about the middle and its anterior and posterior parts about equal in size. In front of the middle the side contours are evenly curved, the anterior end is broadly rounded with a symmetrical rostrum; behind the middle the side contours are undulated in about the same way as in the accompanying fig. 2, the posterior end is somewhat pointed. The surface of the shell is bare; no sculpture was perceptible on the specimen investigated by me. Seen from inside: Selvage: On the rostrum this is smooth-edged and without any spine. Along the anterior margin of the shell and the anterior half of the ventral margin it is extremely finely serrulated, almost smooth; along the posterior half of the ventral margin it is finely serrulated. Along the posterior margin of the shell it is more or less coarsely and irregularly serrulated and scratched and partly furnished with small leaf-like appendages of the type that is reproduced in my fig. 4 of *C. symmetrica*. The glands are as described by G. W. MÜLLER. The glands along the posterior margin of the shell are of about the same type as has been described for *C. Gaussi*, but the little group of three or four glandular exits is absent. There is a rather well developed oval hinge-socket and hinge-tooth at the posterior dorsal corner.

First antenna: — This is of the type described and reproduced by G. W. MÜLLER; in the specimen investigated by me the a-bristle was somewhat longer than the second joint of this antenna (see the accompanying fig. 3). E-bristle: On the anterior side of this bristle

there is proximally of the rows of spines a sparse row of rather short and powerful secondary bristles. In the specimen investigated by me there were 65—67 spines in each posterior row. Distally of these rows of spines this bristle is quite without armature. All the joints are bare. There are a number of yellowish-brown corpuscles in the first joint.

S e c o n d a n t e n n a : — P r o t o p o d i t e : In the specimen investigated by me this part measured 1.35 mm. E x o p o d i t e : The proportion between the length of this branch and that of the protopodite is about 11 : 20. The proportion between the length of the first joint and the total length of the eight following joints is about 10 : 4. The proportion between the length of the longest natatory bristles and that of the exopodite is about 5 : 3.

Fig. CXXXI. *Conchoecia lophura* G. W. Müller ♂. 1. Shell seen from the side; 29 ×. 2. Shell seen from below; 29 ×. 3. Distal part of the left first antenna and the rod-shaped organ, the b-, d- and e-bristles of the antenna are broken; 133 ×. 4. Endopodite of the right second antenna seen from inside, the long bristles are broken; 233 ×. 5. Clasping appendage of the left second antenna; 233 ×. 6. Proximal tooth-list of the right mandible seen from inside; 800 ×. 7. Endopodite of the mandible, the bristles are broken; 160 ×. (From station 64 b.)

The first joint has spines proximally-dorsally, as in my fig. 12 of *C. symmetrica*. E n d o p o d i t e: This is of about the type described and reproduced by G. W. MÜLLER; see the accompanying figs. 4 and 5. First joint: The processus mammillaris is pointed. The a-bristle has short hairs. The b-bristle on both the right and the left endopodite was furnished somewhat proximally of the middle with a group of twelve long hairs; distally of this group there are a moderate number of rather powerful spines. Second joint: The g-bristle is somewhat (about a fifth) longer than the protopodite, not sword-shaped distally and is furnished with sparse short hairs. The f-bristle is of about the same type as the g-bristle, but about a fifth shorter than this, bare or furnished with short hairs. Third joint: The h-, i- and j-bristles are subequal; the proportion between their length and that of the g-bristle is about 2 : 5. The clasping organs have a short hyaline papilla distally and are moderately strongly cross-striated distally. In the proximal part of this branch there were a number of small yellowish-brown corpuscles in the specimen investigated.

M a n d i b l e: — P r o t o p o d i t e: Coxale: The toothed list on the pars incisiva has about ten or eleven teeth. The distal tooth-list is of about the same type as has been previously described for *C. oblonga*. The proximal tooth-list is rather slightly narrower than the distal one; as is the case in most species it is presumably of a som what varying type; in the specimen investigated by me it was about the same as in the accompanying fig. 6. The masticatory pad is relatively narrow, only about half as wide as the proximal list, divided into from three to five transverse ridges and furnished with fine papillae situated close together. The part that is surrounded by lancet-bristles and hairs is raised somewhat like a pad and is also furnished with fine papillae situated close together. Between this part and the masticatory pad there are, as in, for instance, pl. IV, fig. 5, C. CLAUS, 1891 a, a couple of low, powerful spines. Basale: The six teeth on the distal edge of the endite have very fine serrulation. The single tooth on the outside of this joint is of about the same type and size as has been described above for *C. elegans*. The e p i p o d i a l a p p e n d a g e is represented by a little verruca with a very short bristle. The e n d o p o d i t e is relatively short and high; see the accompanying fig. 7. The first joint has four short-haired bristles on the posterior side, of about the same relative lengths as in my fig. 22 of *C. symmetrica*.

M a x i l l a: — E n d o p o d i t e: The distal spines on the first joint are unusually long, about half as long as the height of the end joint. The end joint is of about the same type as in *C. serrulata*.

F i f t h l i m b: — This is of the same type as in my fig. 27 of *C. symmetrica*, but the endopodite has no spines and the middle end claw of the exopodite is relatively longer. On the first exopodite joint I found two bristles in the medial-ventral group, four or five in the proximo-ventral group and three or four in the disto-ventral group. Pilosity: The protopodite and the first exopodite joint are partly furnished with rather long hairs.

S i x t h l i m b: — The dorso-lateral bristle on the first exopodite joint was absent in the specimen investigated by me.

S e v e n t h l i m b: — The end joint has spines.

P e n i s: — This is of about the type reproduced in my fig. 32 of *C. symmetrica*

Furca: — Behind the claws there is an unpaired, long-haired bristle which is about as long as the seventh or eighth claw.

The rod-shaped organ is as described and reproduced by G. W. MÜLLER; see the accompanying fig. 3.

The upper lip and paragnates are of the same types as in my figs. 37 and 38 of *C. symmetrica*.

Remarks: — G. W. MÜLLER in his work of 1908 (p. 74) points out that *C. magna*, CH. JUDAY, 1906, p. 19 is not a synonym of *C. magna* C. CLAUS; MÜLLER writes with regard to the description given by JUDAY: „eher paßt sie zu *Conchoecia lophura* G. W. MÜLLER". The same writer, in his synoptic work of 1912, puts this species of CH. JUDAY'S as a synonym of *C. lophura*, but adds a query. It can be considered beyond doubt that *C. magna* CH. JUDAY is not a synonym of *C. magna* C. CLAUS. Certainly its identity with *C. lophura* seems to me far from impossible, but it is so uncertain that it did not seem to me proper to include the name in question in the list of synonyms given above.

To judge from FOWLER's description it seems very probable that G. H. FOWLER's „*Lophura*-stage" of *C. hyalophyllum* is identical with *C. lophura*; see p. 565 above.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth 2500—0 m.; 23. VI. 1902: 1 mature male; on slides in the collections of R. M. S.

Distribution: — Atlantic Ocean from about lat. 46° N. (G. H. FOWLER) to lat. 35° S. (G. W. MÜLLER), Indian Ocean (G. W. MÜLLER).

The station of the Swedish „Antarctic" Expedition is consequently situated somewhat south of the distributional area stated by previous authors.

Conchoecia parvidentata G. W. MÜLLER.

Conchoecia parvidentata, G. W. MÜLLER, 1906 a, p. 100; pl. XX, figs. 11—18.
„ „ „ „ „ 1908, p. 73.
„ „ „ „ „ 1912, p. 83.

Description: — G. W. MÜLLER, 1906 a, p. 100.

Supplementary description: — Female: —

Shell: — The specimens investigated by me were from 2,4 to 2,7 mm. long. The sculpture varied to some extent, sometimes resembling the type reproduced by G. W. MÜLLER for *C. lophura* and exceedingly difficult to observe. The selvage, the glands along the posterior margin of the shell and the hinge were of the types described above for *C. lophura*. In other respects it agreed with G. W. MÜLLER's statement.

F i r s t a n t e n n a: This is of the type reproduced by G. W. MÜLLER. The e-bristle is, as far as I could discover, bare on the anterior side. The second joint is partly furnished with short spines, the end joints are furnished with moderately long hairs. The first and second joints have numerous small yellowish-brown corpuscles.

S e c o n d a n t e n n a: — Of the same type as in *C. lophura.* The first joint of the e x o p o d i t e is almost or quite bare. The small end joint on the e n d o p o d i t e is, at least in some cases, rather distinct. A rather short c- or d-bristle is sometimes developed on the second endopodite joint. Between the h-and i-bristles there is a small papilla. The armature of the b-bristle is more powerful than that of the a-bristle. The second endopodite joint is bare.

Fig. CXXXII. *Conchoecia parvidentata* G. W. MÜLLER. 1. Distal part of the rod-shaped organ. ♀; 207 ×. (From a specimen from station 64 b.)

M a n d i b l e: — As in *C. lophura,* but only the long lateral bristle is developed on the posterior side of the first endopodite joint, the three medial ones are quite absent. The e p i p o d i a l a p p e n d a g e is sometimes represented by a verruca without any bristle.

The m a x i l l a, the f i f t h and s e v e n t h l i m b s, the f u r c a and the u p p e r l i p are of the same types as in *C. lophura.* The s i x t h l i m b is of the type reproduced in my fig. 30 of *C. symmetrica.*

The r o d - s h a p e d o r g a n varies somewhat; it is sometimes of the same type as in *C. lophura*; see the accompanying fig. 1.

Habitat: — A n t a r c t i c O c e a n:

S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth 2500–0 m.; 23. VI. 1902: 6 mature females; R. M. S. 294.

Distribution: — Atlantic Ocean between lat. 31° N. and lat. 43° S. Indian Ocean. My specimens were consequently caught somewhat south of the distributional area stated by G. W. MÜLLER.

Conchoecia hyalophyllum C. CLAUS.

Conchoecia hyalophyllum, C. CLAUS, 1890, p. 11.
„ „ „ „ 1891 a, p. 60; pl. VI, figs. 2–10; pl. VIII, fig. 9.
„ „ G. S. BRADY and A. M. NORMAN 1896, p. 692 (a reproduction of the original description).
„ „ G. W. MÜLLER, 1906 a, p. 101; pl. XX, figs. 19—26.
„ „ „ „ „ 1908, p. 74.
„ „ (part.), G. H. FOWLER, 1909, pp. 236, 265, 287; pl. XIX, figs. 93—96, 105; pl. XX, figs. 97, 106, 107.
„ „ G. W. MÜLLER, 1912, p. 83.

Description: — See C. CLAUS 1891 a, p. 60 and G. W. MÜLLER, 1906 a, p. 101.

Supplementary description: — Female: —

Shell: — Length: According to C. CLAUS 1.5—1.6 mm. According to G. W. MÜLLER 1.65—1.8 mm. According to G. H. FOWLER 1.4—1.7 mm. The female investigated by me was 1.6 mm. long. The shape of the shell was as described by G. W. MÜLLER. The surface of the shell was bare. The selvage was as in *C. lophura*. The glands along the posterior margin of the shell and the hinge were the same as in *C. lophura*. In other respects it agreed with G. W. MÜLLER's account.

The first antenna was similar to that of *C. parvidentata*, but the distal joints on the specimen investigated by me were bare. In addition this specimen had no small yellowish-brown corpuscles in the first and second joints.

Second antenna: — Similar to that of *C. parvidentata*, but the armature on the a-bristle was almost as powerful as that on the b-bristle. There was no c- or d-bristle.

Mandible: — The protopodite and the epipodial appendage are similar to those of *C. lophura*. The endopodite is perhaps somewhat more elongated than in the species just mentioned. Its first joint has only two bristles on the posterior side; both these bristles have short hairs; one of them corresponds in position and size to the lateral one, the other to one of the three medial ones, of the corresponding bristles in *C. lophura*. It is to be noted that in pl. VI, fig. 7, C. CLAUS, 1891 a, there are three bristles at the corresponding place, one long one and two short ones.

The maxilla, the fifth and sixth limbs, the furca and the rod-shaped organ are similar to those of *C. parvidentata*.

Upper lip: — The part between the combs is of about the same type as in my fig. 4 of *C. Belgicae*. The paragnates are similar to those of *C. symmetrica*.

Remarks: — Besides the places given in the above list of synonyms *C. hyalophyllum* is mentioned in the following places: G. S. BRADY, 1902 a, p. 199 (= the same author, 1903, pp. 337, 338, 339 and A. M. NORMAN, 1905, p. 155) and G. H. FOWLER, 1903, p. 121. These statements are not accompanied by any verificatory information or figures. On account of the great difficulty in determining with certainty the species of this group it did not seem to me proper to include these statements in the list given above.

C. hyalophyllum, CH. JUDAY, 1906, p. 20 is certainly not identical with *C. hyalophyllum* C. CLAUS. It is perhaps identical with the former author's *C. magna*; cf. p. 692 above.

With regard to *C. hyalophyllum*, G. H. FOWLER, 1909 I refer to what is written on p. 565 above. I was unable to discover in the specimen investigated by me any lateral glands with exits such as are shown in this writer's pl. XX, fig. 97.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth 2500—0 m.; 23. VI. 1902: 1 mature female; on slides, R. M. S.

Distribution: — Atlantic Ocean between lat. 46° N. (G. H. FOWLER) and lat. 36° S. (G. W. MÜLLER). Indian Ocean (G. W. MÜLLER).

The female described above was consequently caught somewhat south of the previously known distributional area.

Conchoecia subarcuata C. CLAUS.

Conchoecia subarcuata, C. CLAUS, 1890, p. 9.
,, *striata*, ,, ,, 1890, p. 12.
,, *subarcuata*, ,, ,, 1891 a, p. 58; pl. III, figs. 3—9; pl. IV.
,, *striata*, ,, ,, 1891 a, p. 62; pl. VIII, figs. 1—6.
,, *subarcuata*, G. S. BRADY and A. M. NORMAN, 1896, p. 691 (= a reproduction of the original description).
,, ,, G. W. MÜLLER, 1906 a, p. 102; pl. XXI, figs. 10—16, 19.
,, ,, ,, ,, ,, 1906 b, p. 7.
,, ,, ,, ,, ,, 1908, p. 74.
,, ,, ,, ,, ,, 1912, p. 83.

Description: — See C. CLAUS, 1891 a, p. 58 and G. W. MÜLLER, 1906 a, p. 102.

Supplementary description: — Male: —

Shell: — Length: According to G. W. MÜLLER, 1,8—2 mm. The specimen investigated by me measured 1,8 mm. The shape, as G. W. MÜLLER pointed out, agrees closely with *C. lophura*. The surface of the shell is bare. The selvage, the glands along the posterior margin of the shell and the hinge are also similar to those of *C. lophura*. The compound glands are of the type described by G. W. MÜLLER; for other characters see this author's work.

First antenna: — This is of the same type as in *C. lophura*, but the armature of the e-bristle is different; cf. G. W. MÜLLER; in the specimen investigated by me I counted nineteen or twenty spines in each row; a number of these were arranged in pairs and some alternated more or less distinctly. The anterior side of this bristle was, as far as I could see, quite bare.

Second antenna: — The protopodite and the exopodite are of the same type as in *C. lophura*, but the first exopodite joint is almost bare. Endopodite: This is of the same type as in *C. lophura*. First joint: The a-bristle is bare or has some short hairs at the middle; the b-bristle is also bare, and has only about three or four long hairs just proximally of the middle. The e-bristle was not developed in the specimen investigated by me.

Mandible (fig. 1): — Of the same type as in *C. hyalophyllum*, but the first endopodite joint is furnished on its posterior side with three bristles, all of which have short hairs; these three bristles correspond in position and size to the long lateral bristle and two of the medial ones in my fig. 22 of *C. symmetrica*.

The maxilla and the fifth and sixth limbs are similar to those of *C. lophura*.

Penis: — Of about the same type as in *C. lophura*; its copulatory appendage is somewhat smaller; cf. the accompanying fig. 2.

Furca: — There was no unpaired bristle behind the claws in the specimen investigated by me; cf., however, pl. VI, fig. 10, C. CLAUS, 1891 a.

The rod-shaped organ is of the type reproduced by G. W. MÜLLER.

The upper lip and the paragnates are about the same as in *C. hyalophyllum*.

Remarks. — In my identification of *C. subarcuata* C. CLAUS I rely entirely on the information given by G. W. MÜLLER, 1906 a, p. 102, as this investigator has re-examined the original material of this species.

It seems to me fairly probable that *C. striata* C. CLAUS is identical with this species; this identification is, however, not quite certain, as the description is too incomplete for certainty of identification; the original material is obviously lost. G. W. MÜLLER adds in 1912 „part." to this name; this is, however, obviously due to a mistake; C. CLAUS had only a single specimen of this species at his disposal, as is shown by a statement of his, 1890, p. 13: „Nur in einem männlichen Exemplar . . . gefunden"; see also G. W. MÜLLER, 1906 a, p. 102 with regard to this identification.

Fig. CXXXIII. *Conchoecia subarcuata* C. CLAUS, ♂. 1. Mandible, the proximo-medial ridge on the basale + the epipodial appendage; 567 ×. 2. Distal part of the penis seen from outside; 567 ×.

C. subarcuata, V. VÁVRA, 1906, p. 33, seems, as G. W. MÜLLER pointed out, 1908, p. 74, not to be identical with C. CLAUS's species of the same name. The description is, however, too incomplete for a certain decision of this question; see, for instance, the shape of the capitulum of the rod-shaped organ in the male, pl. I, fig. 9; in any case the difficulty of distinguishing the species in this group is too great to justify us in accepting straight off all the 44 stations included by V. VÁVRA.

C. subarcuata is also mentioned by P. T. CLEVE, 1905, p. 130. As this writer gives no verificatory information at all it seemed to me best not to include this name in the above list of synonyms.

C. striata, G. S. BRADY, 1902 a, p. 190, is not a synonym of the species dealt with here; this was established by me by a re-examination of this writer's original material. I was unfortunately unable to establish with full certainty the species to which this material (a mature male) belonged.

Habitat: — Atlantic Ocean:

S. A. E., Pl. station 19, lat. 36° 13′ N., long. 17° 16′ W.; at the surface; 4. XI. 1901; temperature, 18.5° C.; 3 juvenes; R. M. S. 295. S. A. E., Pl. station 23, lat. 34° 2′ N., long. 18° 21′ W.; at the surface; 5. XI. 1901; temperature, 20.1° C.; 1 mature male; on slides, R. M. S.

Distribution: — Atlantic Ocean between lat. 37° N. (C. CLAUS) and lat. 56° S. (G. W. MÜLLER), Indian Ocean (G. W. MÜLLER).

Conchoecia spinirostris C. Claus.

Conchoecia spinirostris (part.), C. Claus, 1874 a, p. 177.
.. .. 1874 b, p. 6; pl. I, fig. 8; pl. II, fig. 11.
.. *pellucida*, G. O. Sars, 1887, p. 80; pl. XI, figs. 1—4; pl. XII; pl. XIII, figs. 1—4.
.. *spinirostris*, C. Claus, 1890, p. 7.
.. .. 1891 a, p. 56; pl. I; figs. 1—12.
.. .. G. W. Müller, 1894, p. 227; pl. 6, figs. 1—9, 13; pl. 37, figs. 10, 11.
.. .. G. S. Brady and A. M. Norman, 1896, p. 689; pl. LX, fig. 22.
.. .. G. S. Brady, 1902 a, p. 190.
.. .. Ch. Juday, 1906, p. 18; pl. III, figs. 4—7.
.. .. (part.), G. H. Fowler, 1909, p. 252; pl. XXIV and XXV.

Description: — See C. Claus, 1891 a, p. 56 and G. W. Müller, 1894, p. 227.

Supplementary description: — Male: —

Shell: — Length: The specimens investigated by me measured 0,9—1,05 mm.; cf. p. 704 below. Length : height about 2 : 1; length : breadth about 2,25 : 1. Seen from the side it is of about the type reproduced in the accompanying fig. 1, i. e. it agrees very well with the figures given by C. Claus and G. W. Müller. Seen from below (fig. 2) it has its greatest width at about the middle and has evenly curved side contours; it is broadly rounded anteriorly, with an almost symmetrical rostrum, and somewhat pointed posteriorly. The shoulder vault is rather well developed and always well rounded. The surface of the shell has a few scattered rather long, soft hairs, especially on or near the rostrum. Seen from inside: Selvage: On the rostrum this is more or less finely and irregularly serrate-edged or almost smooth; it is about as wide as in pl. 37, fig. 10, G. W. Müller, 1894 (consequently rather considerably wider than in pl. I, fig. 2, C. Claus, 1891 a) and has no large spine-like process. Along the anterior margin of the shell and the anterior part of the ventral margin it is quite smooth-edged or exceedingly finely serrulated; along the posterior half of the ventral margin of the shell and for a short distance along the most ventral part of the posterior margin it is finely serrulated; inside the remaining part of the ventral half of the posterior margin of the shell the marginal spines of the selvage are somewhat larger than the more ventral ones. The unsymmetrical glands have their exits at the usual place. There are no lateral corner glands. On the anterior margin, just ventrally of the rostrum, I have not found „dicht nebeneinander zwei je nach Erhaltung und physiologischem Zustand mehr oder weniger auffällige Drüsen"; cf. G. W. Müller, 1906 a, p. 99. The medial glands along the posterior margin of the shell are of about the same type as is described for *C. oblonga* on p. 618 above. I did not succeed in discovering as deep a junction between the lamellae of the shell inside the rostral incisur as in pl. 37, fig. 10, G. W. Müller, 1894; on the other hand I was able to find

the round joined part ventrally proximally on the rostrum which is reproduced in the figure just mentioned. At the postero-dorsal corner of the shell there is a rather weakly developed hinge-socket and hinge-tooth, of about the same types as in pl. II, fig. 1 (of *C. magna*, ♀), C. CLAUS, 1891 a.

F i r s t a n t e n n a: — The b-, d- and e-bristles are in most cases subequal, about a quarter or a fifth longer than the joints of this antenna. The e-bristle had the following

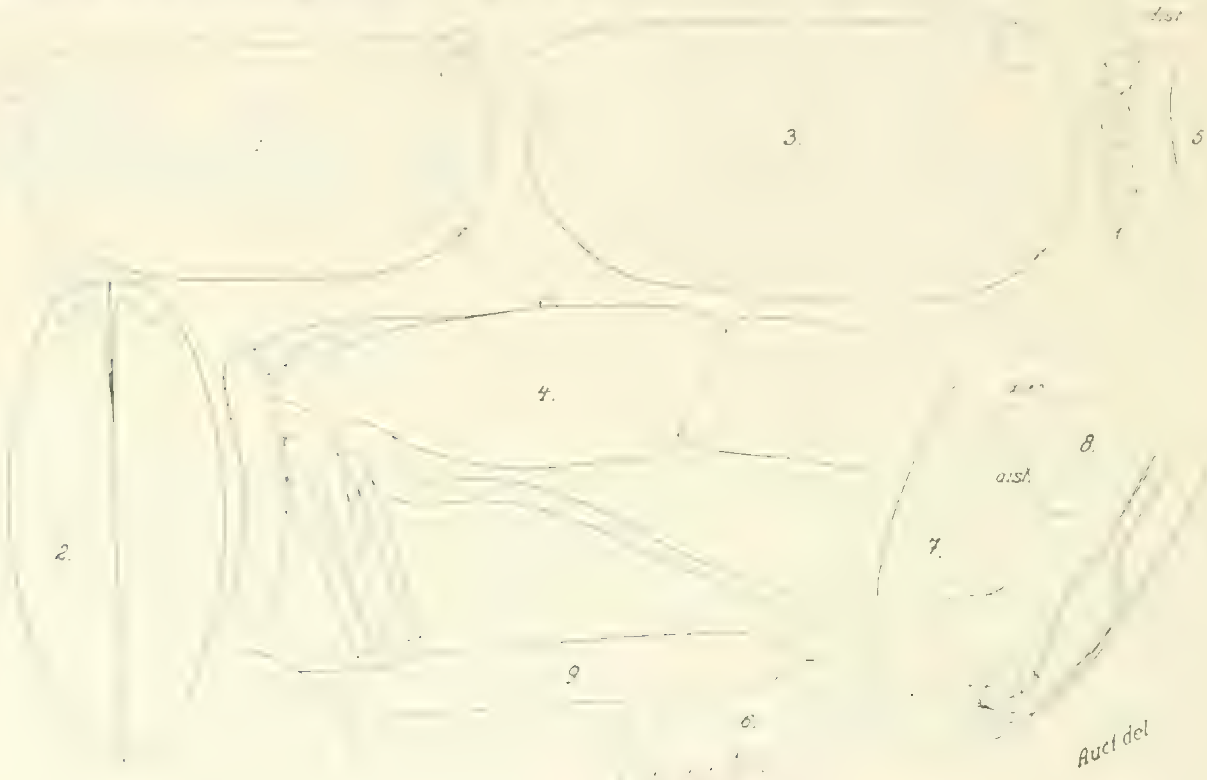

Fig. CXXXIV. — *Conchoecia spinirostris* C. CLAUS. — 1. Shell seen from the side, ♂; 60 ×. 2. Shell seen from below, ♂; 60 ×. 3. Shell seen from the side, ♀; 68 ×. 4. Left first antenna and the rod-shaped organ, the b-, d- and e-bristles of the antenna are broken, ♂; 400 ×. 5. Equipment of the e-bristle of this antenna; the fourth to the seventh spines counting from the point of the bristle, ♂; 1267 ×. 6. The proximal tooth-list of the right mandible seen from inside, ♀; 1200 ×. 7. Distal part of the penis seen from outside; 567 ×. 8. Copulatory appendage of the penis; 567 ×. 9. Distal part of the rod-shaped organ, ♀; 567 ×. (Figs. 1, 2, 4, 7, 8 from specimens from station 33; fig. 3 from a specimen from station 19; fig. 5 from a specimen from station 53 and figs. 6 and 9 from a specimen from station 45.)

armature in the specimens investigated by me (cf. for other details pp. 702—706 below): Somewhat distally of the middle this bristle has two rows of proximally pointing spines along about a quarter of its length. The distal spines in each of these rows are situated close together; these spines are situated in pairs in the two rows. From the eighth or the tenth pair, counting distally-proximally, the two rows approach each other and the spines push alternately in between each other, so that a single, though not a quite straight, row is formed; at the same time the distance between the spines increases, some of these being often even rather sparsely situated (about the same as in pl. 6, fig. 5, G. W. MÜLLER, 1894). In profile I saw about 20—25 spines

(it is to be noted that the distal double row is here counted singly). C. CLAUS makes no direct statement as to the shape of these spines; he only denotes the distal ones as „Häkchen", the proximal ones as „Hakenspitzen". G. W. MÜLLER denotes the distal ones as „kräftig, solid", the proximal ones as „borstenförmig". As far as I could see (with REICHERT's ocular 4, LEITZ's immersion $^1/_{12}$) the distal spines are of about the type reproduced in the accompanying figure 5, i. e. they are furnished along the side that is turned towards the point of the bristle with a wing-like appendage and with a more or less narrowly oval plate distally; the more proximally these „spines" are situated on the bristle, the smaller the wing-like appendage and the distal plate become; on about the eighth to the tenth pair of spines these appendages are scarcely perceptible; the proximal spines are narrow and pointed. Distally of these rows of spines this bristle is quite bare. (More or less distally pointing spines such as are found in several species of this genus, e. g. *C. oblonga*, are thus quite absent.) Just distally of these rows of spines this bristle is bent at a rather decided angle; the part of the bristle distally of this knee is not widened. On the anterior side this bristle is almost quite bare. The b- and d-bristles are in most cases bent at a rather distinct angle at about the corresponding place as the e-bristle and are not widened distally; at about the corresponding place as the rows of spines on the e-bristle they are furnished rather sparsely with short, exceedingly fine, distally pointing spines. None of these three bristles has pad-like formations. The a-bristle is relatively long (see the accompanying fig. 4); when it points backwards, it reaches in most cases to about the middle of the first joint of this limb, sometimes it is rather slightly shorter or longer; it has no accessory saccule. The c-bristle is quite short, about as long as or rather slightly longer than the distal height of the second joint. This bristle is more or less straight; the a-bristle too is most frequently rather straight, at any rate it is not strongly rolled up. All the joints are quite bare.

S e c o n d a n t e n n a: — P r o t o p o d i t e: In specimens with shells about 1 mm. long this part attained a length of about 0,5—0,55 mm. The distal-medial verruca varies in shape, being in most cases somewhat irregularly lobate. E x o p o d i t e: The proportion between the length of this branch and that of the protopodite is about 1 : 2. The proportion between the length of the first joint and the total length of the eight following joints is about 2 : 1. The proportion between the length of the longest natatory bristles and that of the exopodite is about 7 : 5. The first joint is in most cases quite bare, at least as far as I could decide with REICHERT's ocular 4, LEITZ's immersion $^1/_{12}$; sometimes, however, it is furnished proximo-dorsally with more or less abundant weak spines. E n d o p o d i t e: First joint: The processus mammillaris has no distal verruca. The a-bristle has short, fine hairs, the b-bristle, which also has short, fine hairs along the greater part of its length, was in all the specimens investigated by me furnished with two rather long hairs somewhat proximally of the middle; in a number of specimens there were from about two to four moderately long hairs close to the two long ones. See pp. 703—706 below with regard to this character. Second joint: The c- and d-bristles are in most cases somewhat shorter than this joint and have short, fine hairs, almost bare. The e-bristle is extremely short (sometimes absent?). The g-bristle is about as long as or rather slightly shorter than the protopodite; it grows gradually narrower distally and is furnished with sparse short hairs. The f-bristle is of about the same type as the g-bristle, but is about

a quarter or a sixth shorter and is bare. Third joint: The clasping organs are of about the types reproduced by G. W. MÜLLER, 1906 a, pl. XXII, figs. 27 and 28. The h-, i- and j-bristles are subequal, about as long as or somewhat shorter or longer than half the length of the g-bristle; along the greater part of their length they are about as wide as the proximal part of the f-bristle, only slightly widened proximally, with rather distinct shafts and with short, fine hairs or almost bare.

M a n d i b l e: — P r o t o p o d i t e: Coxale: The toothed edge on the pars incisiva has about ten teeth. The distal tooth-list is of about the same relative size and type as has been described above for *C. oblonga*. Proximal tooth-list: This is rather slightly narrower than the distal one and varies somewhat in type; its teeth, which vary in number between about ten and eighteen, are sometimes developed in about the same way as is shown in fig. 6, i. e. they are all conical, more or less pointed, smooth, the posterior ones rather large and powerful, the others decreasing rather evenly in size and strength the more anteriorly they are situated, or else they are more unequal in strength and shape, the anterior ones being smaller and more numerous. On the inside this tooth-list is furnished with numerous short, fine spines situated close together. The masticatory pad is of about the type that is reproduced by C. CLAUS, 1891 a, pl. I, fig. 9, i. e. it is relatively narrow, being only about half the width of the tooth-lists, and is divided into about four to six transverse ridges, which are armed with rather small, low, irregular papillae. In addition there are, close to the side of the masticatory pad that points towards the lancet-bristles, a couple of low verruciform spines like those in the figure just mentioned. Basale: The six teeth on the distal edge of the endite are furnished with rather fine serrulation. The single tooth on the outside of this endite is of about the same type and size as in my fig. 19 of *C. symmetrica*; its serrulation is very difficult to discover; the shape varies, however, to some extent. The e p i p o d i a l a p p e n d a g e consists of an extremely small verruca with or without a very short and fine bristle. (This appendage is sometimes so small that it is scarcely perceptible with REICHERT's ocular 4, LEITZ's immersion $^1/_{12}$.) E n d o p o d i t e: The first joint has only two posterior bristles, both of which have short hairs, one situated somewhat laterally and rather long, about as long as the anterior side of the endopodite, the other, situated somewhat medially, is only about a third or a half the length of the former one. Pilosity: The rows of hairs on the posterior side of the basale are represented by only a few hairs.

M a x i l l a: — P r o t o p o d i t e: Endite on the coxale: On the posterior process there are only three, not four tube-bristles, as is usual in this genus. E n d o p o d i t e: The ventral side of the end joint is about as long as the distal width of the first endopodite joint (calculating from front to back), its dorsal side is about half as long.

F i f t h l i m b: — P r o t o p o d i t e: The longer of the two tube-bristles on the second endite has short hairs. E n d o p o d i t e: Of the three ventral-anterior bristles one is usually of the same length and type as the long bristle on the first endite and has in most cases long secondary bristles, one is about as long as or slightly shorter than the former, but has short hairs, the third is relatively short and weak, often about half or a third the length of the longest claw on this branch, and has short hairs. The dorsal tube-bristle is relatively short, often only about half as long as the short claw; the other tube-bristle is also rather short. This branch has no spines. E x o p o d i t e: First joint: This has one or two medio-ventral bristles, in most

cases subequal, about as long as the proximal height of this joint; both have short hairs or else one of them has rather long secondary bristles. The proximo-ventral group of bristles has three or four bristles, which vary in length, the longest being sometimes about as long as or even somewhat longer than the medio-ventral bristles, the shortest about half as long; they are all often furnished with short hairs, sometimes one of them has rather long secondary bristles. The distal-ventral group of bristles consists of two or three bristles, in most cases with short hairs; the length of these bristles most frequently varies within the same limits as in the case of the bristles in the proximo-ventral group. The dorso-lateral bristle is relatively short, often only about as long as the height of this joint, and is furnished with long hairs. End joint: The dorsal claw is about a third shorter than the middle claw or even somewhat shorter. Pilosity: The protopodite and the first exopodite joints are sometimes furnished with sparse hairs, but in most cases they are bare.

Sixth limb: — The endopodite most frequently has only one bristle, but I discovered two at least in one case; in this case, however, one was rather short. Exopodite: The first joint is in most cases quite without bristles; in one case a very short dorso-distal bristle was observed. The bristle on the second joint is exceedingly short, verruciform, scarcely perceptible with REICHERT's ocular 4, LEITZ's immersion $^1/_{12}$. The dorsal bristle on the third joint is of the usual size and type, the ventral one is like that on the preceding joint.

Penis: — This is of about the type reproduced by G. W. MÜLLER, 1894, pl. 6, fig. 13; cf. the accompanying fig. 7. At about the middle it is furnished with a series of from four to eight oblique transverse muscles (the more numerous these are the narrower they are), distally of which there are no muscles. It has a rather large copulatory appendage of varying shape; cf. the accompanying figs. 7 and 8.

Furca: — There is no unpaired bristle behind the claws.

Rod-shaped organ: — The shaft reaches to about the proximal boundary of the third joint of the first antenna or to the point of this limb. The capitulum (cf. the accompanying fig. 4) is in most cases somewhat shorter than the second joint of the first antenna and is of the type described and reproduced by G. W. MÜLLER.

Upper lip: — The part between the combs on the posterior ventral edge of this lip is almost straight or rather weakly concave; it is sometimes of the same type as in my fig. 37 of *C. symmetrica*, sometimes more notched in the middle. The paragnates are about the same as in the species just mentioned.

Female:

Shell: — Length: The specimens investigated by me measured 1,1—1,15 mm.; cf. below. Length : height about 2,1 : 1; length : breadth about 2,5 : 1. Seen from the side (see the accompanying fig. 3) it is of about the type reproduced by C. CLAUS and G. W. MÜLLER. Seen from below it is of about the same type as that of the male, but, as is seen from the figures given above, it is relatively narrower. Seen from inside: The selvage on the rostrum has a smooth edge or is rather finely and irregularly serrate and is furnished with a spine as in pl. 37, fig. 11, G. W. MÜLLER, 1894. In other respects it resembles that of the male.

F i r s t a n t e n n a: — This is of the type reproduced by C. CLAUS, 1891 a. The first and second joints are only slightly separated. The second joint has no bristles. The e-bristle is characterized by the fact that it has rather numerous moderately long, fine hairs along the anterior side of its proximal third; it is not sword-shaped distally. There were no yellow pigment corpuscles in this limb in the specimens investigated by me. This antenna is bare.

S e c o n d a n t e n n a: — The p r o t o p o d i t e is almost as well developed as in the male. The proportion between the length of the protopodite and that of the e x o p o d i t e is about the same as in the male. E n d o p o d i t e: This has two joints; I did not succeed in discovering any boundary between the original second and third joints. The type is about the same as in C. CLAUS's pl. I, fig. 5, 1891 a and G. W. MÜLLER's pl. 6, fig. 7, 1894. The a- and b-bristles have short hair . The g-bristle is about half as long as the protopodite, not or only slightly sword-shaped distally and furnished with sparse short hairs. The f-, h-, i- and j-bristles are of somewhat different lengths, about a third or a fifth shorter than the g-bristle, bare and with scarcely perceptibl shafts; otherwise they are of the same type as in the male. I was not able to discover any bristle between the h- and i-bristles. Pilosity: The second endopodite joint is bare.

S i x t h l i m b: — Unlike what is the case in the male this is equipped with the normal number of bristles for this genus. E x o p o d i t e: All the bristles on the first joint are relatively short and weak; the dorso-lateral one especially is very much shortened; it is about as long as or even somewhat shorter than the dorso-distal one. Some of the ventral bristles on this joint often have short hairs; the dorso-lateral one has in most cases rather long hairs. End joint: The dorsal claw and the ventral claw are often only about half as long as the middle claw.

R o d - s h a p e d o r g a n: (fig. 9) — This is of the type reproduced by the abovementioned writers; it has two fine points distally and is bare; cf. p. 707 below.

Remarks: — The species *C. spinirostris* described by C. CLAUS, 1874 a and b is presumably not a unit, as it is rather probable that the males and females grouped under this name belong to different species. The descriptions and figures of both sexes are extremely incomplete and do not permit of a quite certain identification of the species. It was also with rather considerable hesitation that I identified the form dealt with by me above with the male of this species of CLAUS's. This identification is based chiefly on C. CLAUS's figure of the first antenna, pl. I, fig. 8. With regard to this figure I wish to point out specially the length of the a-bristle and the armature of the e-bristle; on the latter bristle we count ten rather strong, closely situated spines (certainly pairs of spines), proximally of which one considerably weaker spine is found. The length of the shell stated by C. CLAUS, namely 1,2—1,4 mm., which may seem, of course, to be evidence against this identification, presumably refers, like other statements in the diagnosis (scarcely three lines in length!), to the female specimens. A comparison between C. CLAUS, pl. I, fig. 1 and the figure 3 inserted here of the female shell should be enough to show with all desirable clearness that the females described by this author under this name in the works mentioned do not belong to the species dealt with by me above; in C. CLAUS's

figure the postero-dorsal corner of the shell is pointed, in mine it is rounded; cf. in addition the proportions of the lengths of the end claws in C. CLAUS, 1874 b, pl. II, fig. 15 with the information given by me above.

It seems to me very probable that G. O. SARS's species *C. pellucida*, 1887, is identical with the form described by me above. This identification is, however, not quite certain, as the original description of this species is unfortunately too incomplete to permit of a quite certain identification*. Among the facts that seem to me specially to support this identification the following may be mentioned: Length of shell : ♂ = 1,15 mm.; ♀ = 1,25 mm. E-bristle on the male first antenna: In pl. XIII, fig. 2 a ten pairs of spines are drawn on this bristle. (The equipment of the b-bristle on the first endopodite joint of the male second antenna is uncertain.) — C. CLAUS put forward as early as in his treatise of 1888 (p. 153) the assumption that this species of G. O. SARS's might possibly prove to be identical with *C. spinirostris*. In his work of 1890 this author writes (p. 7) these two names as certain synonyms; this procedure has since been followed by almost all subsequent writers.

The certainty of the identification of *C. spinirostris*, C. CLAUS, 1890 and 1891 a with the species described by me above may be taken as being complete. The following characters may be specially mentioned: Length of shell: ♂ = „circa 1,1 mm.“; ♀ = „circa 1,25 mm.“ With regard to the e-bristle on the male first antenna this author writes, 1891 a, p. 56: „mit nur 8 bis 10 Häkchenpaaren besitzt, auf welche noch vereinzelte, unregelmäßig gestellte Hakenspitzen in weitem Abstande folgen**“. According to pl. I, fig. 6, 1891 a, the b-bristle on the endopodite of the male second antenna has only two long hairs.

It may also be said that there is full certainty with regard to the identification of *C. spinirostris*, G. W. MÜLLER, 1894 with the species dealt with above. The following information with regard to the characters just mentioned is given in the work quoted: Length of shell: ♂ = 1,0—1,1 mm.; ♀ = 1,1—1,18 mm. Male first antenna: We read about the equipment of the e-bristle: „Bis zum 11. oder 12. folgen sich die Haken in kurzer Entfernung, stehen paarweis, dann rücken sie weiter und weiter auseinander und stehen einzeln, um sich schließlich wieder rascher zu folgen. Nach dem 11. Hakenpaare kommen noch etwa 12 Borstenhaken, die zum Theil schwer zu erkennen sind.“ The b-bristle on the first endopodite joint of the male second antenna is furnished with two long hairs.

I have also included without hesitation *C. spinirostris*, G. S. BRADY and A. M. NORMAN, 1896 in the list of synonyms given above. With regard to the e-bristle on the male first antenna we read as follows in the treatise mentioned: „. . . . having only eight or ten pairs of hooked marginal appendages following which, but separated by wide intervals, are some hook-like processes of irregular size.“ The length of the shell and the b-bristle on the endopodite of the male second antenna are not mentioned in this work.

The synonymization of *C. spinirostris*, G. S. BRADY, 1902 a with this species is based on a re-examination of this writer's original material. It is to be noted that this synonymization

* According to a communication I received from this writer the original material of this species has unfortunately been lost.

** In the figure with which C. CLAUS illustrates this description, pl. I, fig. 4, this bristle is, however, armed with fourteen „Häkchenpaaren“, proximally of which there are no spines at all.

only applies to the first of the two finds included in this work of BRADY's. The specimens from the Pacific have not been investigated by me.

The form *C. spinirostris* described by CH. JUDAY, 1906 also shows very far-reaching agreement with the species described by me above. With regard to the above-mentioned characters this writer states: Length of shell: ♂ = 1,0—1,1 mm., ♀ = 1,1—1,4 mm. The e-bristle on the male first antenna: „the distal eleven or twelve pairs of hooks large, strong and closely set, followed proximally by ten or twelve much smaller ones which are farther apart." The b-bristle on the endopodite of the male second antenna is furnished with two long hairs.

Finally the form described by G. H. FOWLER, 1909, under the name of *C. spinirostris*, „Stage II (*spinirostris* stage)" is certainly identical with the species dealt with here. The following information is given about the above-mentioned characters: Length of shell: ♂ = 0,9 to 1,0 mm.; ♀ = 1,0—1,2 mm. E-bristle on the male first antenna: „about 8—11 pairs of saw-teeth and 8—9 pairs of spine-teeth". The b-bristle on the endopodite of the male second antenna has two long hairs. With regard to the armature of the e-bristle this writer must certainly have made a mistake; the „eight or nine pairs of spine-teeth" mentioned certainly represent a single row of eight or nine spines.

It will be seen form this that the forms included in the list of synonyms given above show very little variation with regard to the three characters in question, the length of the shell, the armature of the e-bristle on the male first antenna and the b-bristle on the male second antenna.

C. spinirostris C. CLAUS is also included in G. W. MÜLLER's large work of 1906 a. In this work we find the following information about the three characters just mentioned: Length of shell: ♂ = 0,95—1,4 mm.; ♀ = 1,1—1,6 mm. E-bristle on the male first antenna: „die Zähnchenreihe der Hauptborste beginnt distal mit einer Doppelreihe sehr dicht stehender breiter Zähne, welche nur wenig Raum zwischen sich lassen. Etwa beim 14. Zahn nähern sich beide Reihen und schieben sich zwischeneinander, so daß sie eine einzige, wenn auch nicht ganz gerade Reihe bilden. Von derselben Stelle an rücken die Zähne weiter auseinander, werden borstenförmig. Man sieht im Profil 30—40 Zähne resp. Borsten (wobei die Doppelreihe einfach gezählt ist)". The b-bristle on the endopodite of the male second antenna is furnished with „eine kleine Gruppe von langen Haaren (fehlen öfters, abgebrochen)"; in pl. XXII, fig. 23 there are five long hairs on this bristle. The difference between these statements and those given above is not inconsiderable.

Among the material investigated by me there were also two mature males, caught at S. A. E., Pl. station 4 b (lat. 25° 51′ N., long. 21° 29′ W.; at the surface; 9. XI. 1901; temperature, 22.50° C.), to which no attention is paid in the description given above. These individuals differed in the following respects from those previously described by me.

S h e l l: — Length, 1,3—1,4 mm.; it was thus rather considerably longer than in those described by me above, but agreed with that of the longest ones investigated by G. W. MÜLLER, 1906 a.

F i r s t a n t e n n a: — The armature of the e-bristle agreed with that given by G. W. MÜLLER, 1906 a, i. e. the distal spines were situated in pairs to about the fourteenth spine and one saw in profile about forty spines (the distal double row being counting singly). The distal ones of these spines had more weakly developed distal plates.

Second antenna: — The b-bristle on the first joint of the endopodite had in one specimen two, in the other three long hairs.

Sixth limb: — The endopodite had two bristles, one of which was rather short. Exopodite: The first joint had one short dorso-distal bristle and one rather short bristle at about the middle of the ventral side.

Are we concerned here with two closely related forms, which were confused by G. W. MÜLLER, 1906 a, or is *C. spinirostris* a species with a relatively great amplitude of variation?

In answering this question the following remark of G. W. MÜLLER, 1906 a, p. 105, has a certain interest: „♀ von über 1,4 und ♂ von über 1,3 fanden sich nur in Station 32—55, wo die Thiere überhaupt im Durchschnitt größer." In the samples investigated by this writer the large and small specimens were thus not mixed up together quite without any principle; on the contrary, at the sixteen stations at which large specimens were caught no small specimens were found, nor were any large specimens found at the 36 stations where the plankton samples contained small specimens. The stations in question, nos. 32—55, are situated in the Atlantic from lat. 24° N. and lat. 2° N.; the depths are only known in two cases, 42 S. = 550—250 m.; 48 S b = 280—130 m. To judge from the latter statements it does not seem probable that this difference in size between the specimens investigated is due to external conditions. It is also to be noted that at S. A. E., Pl. Station 4 b no small specimens were found, and that no large specimens were found at those stations of this expedition from which the small specimens described by me above came.

G. W. MÜLLER, in his work of 1906 a just mentioned, put forward the assumption that *C. porrecta* C. CLAUS was a synonym of *C. spinirostris*. „Ich halte *C. porrecta* CLAUS nur für gestreckte Individuen von *C. spinirostris*." (The identification was not based on a re-examination of C. CLAUS's original material, as is shown by a statement on p. 105 in the work quoted.) It is certain that these two forms are very closely related to each other. According to the description and figures *C. porrecta* differs from *C. spinirostris* chiefly in the following characters: Length of shell: 1,6 mm. (this statement, like, as a matter of fact, the whole description of the shell, certainly refers to female specimens). Male first antenna: The a-bristle is relatively short, reaching only to about the boundary between the first and second joints of this limb. E-bristle: „. . . . mit sehr zahlreichen, wohl 40—50 Paaren von Häkchen besetzt, von denen die 14—16 distalen Paare viel dicker und dichter gestellt sind, die nach der Basis zu folgenden in weiteren Zwischenräumen stehen und zu Stachelborsten werden." (The b-bristle on the first endopodite joint of the male second antenna is not mentioned or reproduced by this writer.)

If we assume that C. CLAUS made a mistake in observation (which does not seem to me improbable on account of the uncertainty that often characterizes the statements as to details given by this writer) and there was not a double but only a single row of spines on the e-bristle of the male first antenna proximally of the fourteen to sixteen distal pairs of spines, then the agreement between the information given by this writer for *C. porrecta* and G. W. MÜLLER's description of *C. spinirostris*, 1906 a, becomes almost complete. The latter writer gives no information as to the a-bristle on the male first antenna. The specimens investigated by me from S. A. E., Pl. station 4 b agreed in this respect with C. CLAUS's statement in the case of

C. porrecta. (In the small specimens described by me above this bristle was always somewhat longer; it reached in most cases to about the middle of the first joint of this limb. The statements about this character vary in the literature, but the certainty of these statements is doubtful, so that I do not think it convenient to deal with it at any length in this connection.)

Do *C. spinirostris* and *C. porrecta* represent two well differentiated forms; is the identification carried out by G. W. MÜLLER unjustified?

It seems to me not improbable that these questions must be answered in the affirmative; if this is the case, then it is clear that my specimens from S. A. E., Pl. station 4 b and the larger specimens of G. W. MÜLLER's species *C. spinirostris*, 1906 a, belong to *C. porrecta*. A definite answer to this problem is, however, not possible at present. A renewed investigation carried out on abundant material would be necessary before it could be given.

On account of this state of uncertainty it did not seem to me proper to include the name of *C. spinirostris*, G. W. MÜLLER, 1906 a, nor the same name in this investigator's works of 1906 b, 1908 and 1912 in my list of synonyms.

The only one of the other writers who has accepted the synonymization *C. spinirostris* — *C. porrecta* is TH. SCOTT, 1912 a.

G. S. BRADY, 1902 a, p. 199 (= 1903, pp. 338 and 339) and V. VÁVRA, 1906, state that they have found *C. porrecta*, but unfortunately these writers give neither description nor figures. V. VÁVRA, who states that he found this species — only female specimens — at no less than fifteen of the stations of the „Plankton Expedition", only writes „diese leicht erkenntliche Art", an expression that is presumably taken direct from C. CLAUS's original description.

G. H. FOWLER, 1909, takes *C. porrecta* as „Stage I" of *C. spinirostris*. Only two specimens, two males, of the first-mentioned form were found in the material in question. Both these specimens had shells 1.3 mm. long. The e-bristle on the first antenna was characterized by „16 pairs of saw-like teeth, followed by about 11 pairs of spine-teeth; the latter so markedly alternate as to suggest a single row unless viewed directly from above"; there were consequently 16 pairs of „saw-like teeth" and a row of 22 „spine-teeth", i. e. about the same number as was found by C. CLAUS, G. W. MÜLLER and me. For other characters see the work in question, p. 252. Cf. also in this matter p. 565 above.

The only writer who has followed this procedure of G. H. FOWLER's is L. SCHWEIGER, 1912. This writers says (p. 266) that he followed G. H. FOWLER and not G. W. MÜLLER „weil mir vereinzelte Stadium II untergekommen sind, die aber doch im Verhältnis gestreckte Formen waren, und umgekehrt Formen von I, die aber weniger gestreckt als die vorher erwähnten waren." No length is given for the „*porrecta* stage"; the males of the „*spinirostris* stage" would have attained a length of 1.02—1.3 mm. and the females 1.12—1.5 mm. The work, which is characterized by a certain amount of uncertainty, has no other information that is of any interest in connection with this problem.

C. spinirostris, V. VÁVRA, 1906, has not been included in the above list of synonyms because this writer states that the females of this species investigated by him had a dorsal bristle on the second joint of the first antenna: „mit sehr feiner, gewöhnlich dem Frontalorgan eng anliegender Dorsalborste, so daß dieselbe von einigen Autoren übersehen wurde"; in plate I,

fig. 7 this antenna has a very powerful bristle of this kind. A very careful investigation of the specimens at my disposal showed that there was no such bristle in the species dealt with by me above. Of the other characters only the length of the shell and the rod-shaped organ in the female are mentioned by V. VÁVRA; these statements do not permit of a certain identification.

The name *C. spinirostris* CLAUS is also found mentioned in the following places in literature: C. CLAUS, 1893, p. 286 and 1894, p. 2; G. W. MÜLLER, 1893, p. 376; E. GRAEFFE, 1900, p. 34; G. S. BRADY, 1902 a, p. 199 (the same author, 1903, pp. 338 and 339 and A. M. NORMAN, 1905, p. 155); S. LO BIANCO, 1903, pp. 120, 122, 124, 125, 128, 148, 150, 199, 235 and 1904, p. 45 (with a very superficial drawing); P. T. CLEVE, 1904, p. 370; B. KAJDIŽ, 1912, pp. 938 and 939 and TH. SCOTT, 1912 a, p. 587. G. W. MÜLLER, 1893, only deals with larvae, and it is impossible to decide their identity with certainty by means of the descriptions he gives. The rest of these statements have neither descriptions nor verificatory figures. Because of this and of the uncertainty attached to this species it seemed to me best not to include these statements in the list of synonyms given above.

Rod-shaped organ.

L. SCHWEIGER in his treatise of 1912 points out (p. 267) „eine Mißbildung" with regard to the rod-shaped organ in four females; this abnormality consisted in the fact that this organ was furnished with two fine distal points. The females of the above-mentioned species investigated by me were characterized, as is seen above, by two similar points on this organ.

A question of the Œcology of reproduction.

Special attention ought perhaps to be drawn to the curious fact that in the plankton samples brought home by the S. A. E. the males of this species were in an enormous majority. Only four females were found, three at station 19 and one at station 45. At station 33 there were found no less than 22 males of this species and not a single female! In other species the males and females were in most cases almost equally numerous or else the latter predominated. How are we to explain this curious state of affairs?

Habitat: — Atlantic Ocean:

S. A. E., Pl. station 19, lat. 36° 13′ N., long. 17° 16′ W.; at the surface; 4. XI. 1901; temperature, 18,5° C.: 3 mature females and 3 juvenes; R. M. S. 296. S. A. E., Pl. station 23, lat. 34° 2′ N., long. 18° 21′ W.; at the surface; 5. XI. 1901; temperature, 20,1° C.: 1 mature male; R. M. S. 297. S. A. E., Pl. station 26, lat. 32° 21′ N., long. 19° 8′ W.; at the surface; 6. XI. 1901; temperature, 20,5° C.: 1 mature male; R. M. S. 298. S. A. E., Pl. station 33, lat. 28° 21′ N., long. 20° 42′ W.; at the surface; 8. XI. 1901; temperature, 21,5° C.: 22 mature males; R. M. S. 299. S. A. E., Pl. station 45, lat. 22° 8′ N., long. 22° 52′ W.; at the surface; 11. XI. 1901; temperature, 23,3° C.: 6 mature males and 1 mature female; R. M. S. 300. S. A. E., Pl. station 53, lat. 18° 10′ N., long. 24° 28′ W.; at the surface; 13. XI. 1901; temperature, 23,8° C.: 1 mature male. S. A. E., Pl. station 83, lat. 1° 31′ N., long. 29° 7′ W.; at the surface; 22. XI. 1901; temperature, 26,8° C.: 1 mature male; R. M. S. 301. S. A. E., Pl. station 95, lat. 3° 7′ S., long. 30° 54′ W.; at the surface; 25. XI. 1901; temperature, 26,3° C.: 2 mature males; R. M. S. 302. S. A. E., Pl. station 127, lat. 20° 35′ S., long. 37° 26′ W.; at the surface; 4. XII. 1901; temperature, about 25° C.: 2 mature males; R. M. S. 303.

S. A. E., Pl. station 134, lat. 24° 21′ S., long. 41° 23′ W.; at the surface; 6. XII. 1901; temperature, 23,2° C.; 1 mature male; R. M. S. 304.

Lat. 42° 09′ N., long. 42° 15′ W.; 1 mature male; on a slide. R. M. S. (coll. unknown).

Lat. 26° 15′ N., long. 20° 56′ W.*; VII. 1895; collector: CHR. LEVINSEN; 6 mature males (= the specimens examined by G. S. BRADY, 1902 a). Stored in the collections of K. Z. M.

Distribution. — Atlantic Ocean from about lat. 45° N. (G. H. FOWLER, 1909) to lat. 26° N. (G. S. BRADY, 1902 a). Mediterranean. Pacific Ocean, at about lat. 33° N. (CH. JUDAY, 1906).

Some of the finds of the Swedish „Antarctic" expedition in the Atlantic are consequently situated considerably more to the south than the most southern point stated in the previous treatises.

Mollis group G. W. MÜLLER.

Of the twelve species in this group I have unfortunately been able personally to investigate so far only *C. borealis*, which is dealt with below. Because of this it is, of course, impossible for me to give any opinion as to whether this group is quite natural or not. Apparently, however, most at least of the species included by G. W. MÜLLER in this group seem to be very closely related to one another.

Conchoecia borealis G. O. SARS.

Conchoecia borealis, G. O. SARS, 1865, p. 119.
„ „ G. S. BRADY and A. M. NORMAN, 1896, p. 685; pl. LXI, figs. 9—19.
„ „ C. W. S. AURIVILLIUS, 1899, pp. 62, 66 (= *C. b.* [part.], P. T. CLEVE, 1900, p. 38).
„ „ H. H. GRAN, 1902, pp. 83, 210.
„ „ P. T. CLEVE, 1903, p. 23.
„ „ P. T. CLEVE and O. PETTERSSON, 1903, pp. 2, 7.
„ „ V. VÁVRA, 1906, p. 48; pl. III, figs. 56—63.

Description: — See G. O. SARS, 1865, p. 119 and V. VÁVRA, 1906, p. 48.

Supplementary description: — Male: —

Shell: — Length: Of the males investigated by me the specimens from Skager Rak measured 2,10—2,20 mm., those from Lofoten 2,15—2,30 mm. and those from the Arctic Ocean 2,3 mm. Length : height about 2,3 : 1; length : breadth about 2,8 : 1. Seen from the side it was of about the type described and reproduced by G. O. SARS, 1900, for *C. maxima*,

* Not 29° 56′ W., as is stated by G. S. BRADY, 1902 a.

(cf. the appended fig. 1), but somewhat, though only rather slightly, varying. Seen from below (see the appended fig. 2) it has its greatest width at about the middle and the anterior part in most cases somewhat larger than the posterior part. The side contours are either evenly curved or else are somewhat undulating posteriorly or slightly concave just in front of the posterior point. The anterior end is rounded and has a symmetrical rostrum, the posterior end is more or less pointed. The shoulder vault is powerfully developed; when the shell is seen from the side it covers a rather long piece of the dorsal margin; it is wing-shaped with a sharp edge along the greater part of its length. The surface of the shell is bare; it is also, as G. S. BRADY and A. M. NORMAN state (1896), „densely cross-hatched with quadrangular reticulations which are arranged diagonally, the edges of the areas overlapping each other in a squamous fashion". The strength of the sculpture was certainly subject to some variation in the specimens investigated by me, but this variation was, all the same, not particularly great. Seen from inside: Selvage: On the rostrum and along the anterior margin of the shell and the anterior half of the ventral margin it is smooth, at least I did not succeed in establishing any distinct serrulation even with REICHERT's ocular 4 and LEITZ's immersion $^1/_{12}$. There is no spine-like process on the rostrum. It is finely serrulated along the posterior half of the ventral margin of the shell; along the ventral half of the posterior margin of the shell it is very narrow and has small leaf-like appendages of about the same type as in my fig.4 of *C. symmetrica*. The glands are as described and reproduced by G. W. MÜLLER, 1906 a, for *C. antipoda*. There is no distinctly developed hinge-socket or hinge-tooth at the posterior dorsal corner of the shell.

First antenna: — E-bristle: This is about one and a third or one and a half times as long as this limb and is bent at a distinct angle at about or somewhat distally of two-thirds of its length. Just proximally of this bend it has along about a third of its length two rows of very short, closely placed, proximally pointing spines, about 50—55 spines in each row; cf. the appended fig. 4. Almost all the spines are of the same size (only the distal ones and the proximal ones are somewhat smaller than the others); they are about as long as the thickness of the bristle and moderately strong, all of them are pointed and are furnished with a wing-like appendage of about the same type as in the appended fig. 5. Just distally of these rows of spines there is in most cases a small chitinous protuberance but, on the other hand, there are no spines at all. The part of the bristle distally of the bend is widened in the shape of a sword. This bristle is quite bare proximally of the rows of spines. The d-bristle is a quarter or a third shorter than the e-bristle. At about the part of this bristle which, when the d- and e-bristles are close together, is situated against the rows of spines on the latter, there are closely placed (not merely in a row but a stripe) short, stiff, fine spines or hairs. On the proximal half (or somewhat more) of this part these spines point almost at right angles to the bristle, on the distal half they point more distally; cf. the appended fig. 15. Opposite these spines and continuing almost out to the point of the bristle there are a moderate number of somewhat longer and thicker spines, pointing distally. This bristle is not sword-shaped distally. The b-bristle is in most cases somewhat longer than the d-bristle and, like it, not sword-shaped distally. Near the point it has a rather strongly developed pad, which is about half the length of the rows of spines on the e-bristle; cf. the appended figs. 6 and 7. Distally of this pad there

Fig. CXXXX. [illegible] G. O. Sars. 1. Shell seen from the side, ♂; 42 ×. 2. Shell seen from below, ♂; 40 ×. 3. Distal part of the right first antenna and the rod-shaped organ, the bristles of the first antenna are broken, ♂; 260 ×. 4. Distal part of the e-bristle of this antenna, ♂; 360 ×. 5. A spine of this bristle; 1084 ×. 6. Distal part of the b-bristle, ♂; 360 ×. 7. Distal part of the pad of this bristle, ♂; 1084 ×. 8. Endopodite of the right second antenna seen from inside, the end bristles are broken, ♂; 260 ×. 9. and 10. Clasping organ of the endopodite of the left second antenna, ♂; 260 ×. 11. Distal part of the penis seen from outside; 400 ×. 12. Distal part of the rod-shaped organ + a part of the first antenna, ♀; 167 ×. 13. and 14. Distal part of the rod-shaped organ, ♀; 167 ×. (Figs. 7 and 13 are drawn from specimens from Skager Rak, the others from specimens from Lofoten.)

are a few rather short, stiff spines, but otherwise this bristle is bare. The a- and c-bristles are subequal, about as long as the second joint of this limb; the a-bristle has an accessory saccule (see the appended fig. 3) and is more or less irregularly bent; the c-bristle has no accessory saccule and is more or less straight. All the joints are quite bare.

S e c o n d a n t e n n a: — P r o t o p o d i t e: In specimens with shells about 2,2 mm. long this part measured about 1—1,1 mm. E x o p o d i t e: The proportion between the length of this branch and that of the protopodite is about 18—20 : 40. The proportion between the length of its first joint and the total length of the eight distal joints is about 10: 4—5. The proportion between the length of the longest natatory bristles and that of the exopodite is about 15—18 : 10. The first joint has spines proximo-dorsally, but these form no distinct row as in my fig. 13 of *C. symmetrica.* E n d o p o d i t e (see my fig. 8): First joint: The processus mammillaris has a small distal verruca. The a-bristle is bare; the b-bristle is bare or has only sparse short hairs. Second joint: The c- and d-bristles are somewhat shorter than this joint and are bare or almost bare. The e-bristle is short. The g-bristle is about as long as or in most cases somewhat shorter than the protopodite; it is rather broadly sword-shaped distally and has sparse short hairs along one edge. The f-bristle is about a third shorter than the g-bristle and is also somewhat sword-shaped distally and in most cases bare. Third joint: The clasping organs are of the types described and reproduced by V. VÁVRA; see the appended figs. 8, 9 and 10. The right clasping organ is in most cases furnished proximally with two verrucae of about the same types as in the figure just mentioned and, in addition, with small, fine spines along the concave side; distally it has transverse creases and an exceedingly small hyaline papilla. The left clasping organ is also cross-grooved distally and has an exceedingly small hyaline papilla; its proximal angle varies somewhat in type. The h-, i- and j-bristles are about half as long as the g-bristle. The h-bristle has a short but very sharply marked shaft, the i- and j-bristles have a shaft that is somewhat longer but only weakly developed. Just distally of the shaft these bristles are somewhat thicker than the g-bristle. All these three bristles are bare.

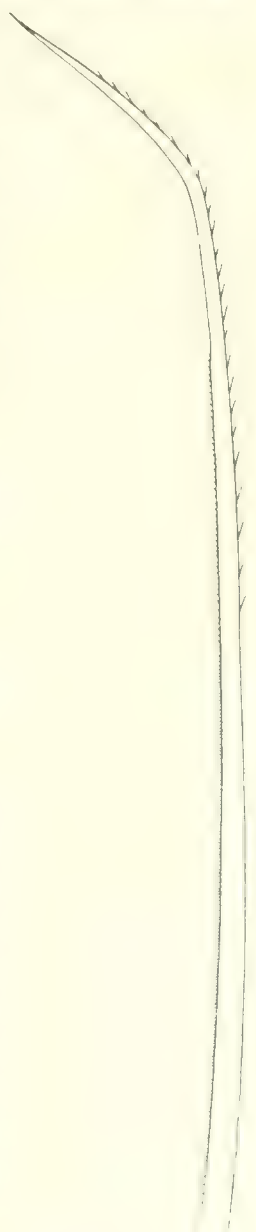

Fig. CXXXVI. *Conchoecia borealis* G. O. SARS, ♂. — 15. Distal part of the d-bristle. 390 ×. (From a specimen from Lofoten.)

M a n d i b l e: — P r o t o p o d i t e: Coxale: The toothed edge on the pars incisiva has from about eight to twelve teeth; this comparatively great variation was not due to the specimens investigated being from different localities, as the extreme numbers could be observed in specimens from the same locality. The posterior ones of these teeth are often somewhat more strongly developed than in my fig. 16 of *C. symmetrica.* Distal tooth-list: This is of about the same relative size and type as has been described above for *C. oblonga.*

Proximal tooth-list: This is rather slightly narrower than the distal one and varies somewhat in type, sometimes approaching the type reproduced in my fig. 6 of *C. lophura*, sometimes agreeing somewhat more with my fig. 18 of *C. symmetrica*. The masticatory pad is of about the same relative size and type as in pl. LXI, fig. 7, G. S. BRADY and A. M. NORMAN, 1896; it is divided into from four to six transverse ridges armed with rather fine papillae placed close together. The part that is enclosed by the margin of bristles and hairs is raised somewhat like a pad and is furnished with fine papillae similar to those on the masticatory pad. Basale: The six teeth on the distal edge of the endite are furnished with rather fine serrulation. The single tooth on the outside of this process is of about the same type as is described above for *C. elegans*. The e p i p o d i a l a p p e n d a g e consists of a rather small verruca and a moderately long bristle. E n d o-p o d i t e: On the posterior side of the first joint there are four bristles of about the same relative lengths and positions as in my fig. 22 of *C. symmetrica*. Either all these bristles are furnished with short hairs or else one or two of the shorter ones have long hairs. Pilosity: The basale has rather sparse moderately long hairs ventero-medially.

M a x i l l a: — P r o t o p o d i t e: Endite on the procoxale: The three antero-inner bristles have rather long secondary bristles, the outer one of them has in most cases, however, only quite a few (sometimes none at all?). One or two of the three postero-outer tube-bristles often have a few similar secondary bristles. E n d o p o d i t e: The end joint is rather long, its ventral side is often somewhat longer than the distal width of the first joint (calculating from front to back), its dorsal side about half as long or somewhat longer.

F i f t h l i m b: — Of the same type as in my fig. 27 of *C. symmetrica*. E n d o p o d i t e: Sometimes only one of the two shorter of the three antero-ventral bristles has short hairs, the other having rather long hairs at the middle. This branch is furnished with spines. E x o-p o d i t e: First joint: The ventero-medial group has two bristles, the proximo-ventral group has four or five and the disto-ventral one three or four. One of the bristles in the proximo-ventral group is usually furnished with long hairs, the others have short hairs. Pilosity: The protopodite and the first exopodite joint are partly furnished with rather long hairs.

S i x t h l i m b: — E x o p o d i t e: The bristles on the second and third joints are relatively long, about as long as the height of the corresponding joint at the middle. The bristles on the first joint are also sometimes relatively long.

S e v e n t h l i m b: — The end joint has spines.

P e n i s: — This is of about the same type as in my fig. 32 of *C. symmetrica*. At the middle it has from about six to nine oblique transverse muscles, distally of which there are no muscles. The copulatory appendage is well developed; it varies somewhat in type, being sometimes of about the type shown in my appended fig. 11, sometimes somewhat lobate, about the same as in my fig. 6 of *C. Haddoni*; in all the specimens investigated by me it was, however, rather high and moderately wide. This variation was not due to the specimens having been caught at different localities; a similar variation was found in specimens from the same locality.

F u r c a: — This is of about the type reproduced in pl. XXXVI, fig. 10, G. O. SARS, 1900, for *C. maxima*; behind the claws there is a short-haired unpaired bristle of about the same length as the fifth claw.

R o d - s h a p e d o r g a n: — The shaft reaches to about the third joint of the first antenna or somewhat farther. The capitulum is about as long as or somewhat shorter than the second joint of the first antenna and of about the type reproduced by G. S. BRADY and A. M. NORMAN, 1896; see the appended fig. 3.

U p p e r l i p: — This is of about the same type as in my fig. 37 of *C. symmetrica*; the part between the combs is sometimes, however, notched somewhat deeper at the middle, about the same as in my fig. 4 of *C. Belgicae*. The p a r a g n a t e s are of about the same type as in my fig. 38 of *C. symmetrica*.

F e m a l e: —

S h e l l: — Length: Of the specimens investigated by me those from Skager Rak measured about 2,5—2,7 mm., those from Lofoten about 2,55—2,9 mm. and those from the Arctic Ocean 2,4—2,7 mm. S e e n f r o m t h e s i d e it is of about the same type as in the male, but is somewhat higher posteriorly. S e e n f r o m b e l o w it is also of about the same type as in the male, but the posterior part is somewhat larger and the side contours evenly curved. The proportion between length and breadth is about 2.5 : 1. In other respects it is like that of the male.

F i r s t a n t e n n a: — The division into joints is rather slight. The dorsal bristle on the second joint is about as long as the total length of the two proximal joints of this limb and has short hairs. The e-bristle is about twice as long as this limb, not at all or only very slightly widened and sword-shaped distally; its anterior side is bare. The a-, b-, c- and d-bristles are subequal, about a third of the length of the e-bristle. The first and second joints are partly furnished with short hairs. These joints have yellowish-brown corpuscles.

S e c o n d a n t e n n a: — The p r o t o p o d i t e is rather slightly weaker than in the male. E x o p o d i t e: The proportion between the length of this branch and that of the protopodite is about 21—22 : 40. The proportion between the joints of this branch is about the same as in the male. E n d o p o d i t e: This has two joints; sometimes, however, the little third joint is weakly marked off. The f- and g-bristles are of about the same type and relative size as in the male. The h-, i- and j-bristles, which have no distinctly developed shafts, are either of about the same relative length as in the male or else rather slightly longer. There is an extremely small papilla between the h- and i-bristles. The second endopodite joint is bare.

R o d - s h a p e d o r g a n: — The shaft reaches somewhat in front of the point of the first antenna; see the appended fig. 12. The capitulum is relatively somewhat shorter than in the male and its shape is about the same as is described and reproduced by V. VÁVRA, but varies to some extent; see the appended figures 12—14.

Remarks: — It seems to be quite certain that the form dealt with above is identical with *C. borealis*, G. O. SARS, 1865. The supplementary description worked out by me is based on material from the type-locality of this species — Lofoten — and this material was defined by G. O. SARS himself as *C. borealis*.

Because of the uncertainty with regard to the relation of this species to the form *C. maxima* established by G. S. BRADY and A. M. NORMAN (cf. below) it is impossible at present to give a complete list of synonyms of this species of G. O. SARS'.

It seems to me rather probable that *C. borealis*, G. S. BRADY and A. M. NORMAN, 1896 is a synonym of this form; the specimens described and reproduced by these writers were presumably caught off the west coast of Norway. The description and figures are, however, exceedingly incomplete and uncertain; it would be superfluous to enter upon a detailed criticism of them; I shall only point out here as an illustration that on the endopodite of the female second antenna the end joint is furnished with six long bristles, a number that is not found in a single species of this genus; two g-bristles are drawn instead of one.

I have myself verified the correctness of the determination of *C. borealis*, C. W. S. AURIVILLIUS, 1899, pp. 62 and 66; cf. p. 717 below.

C. borealis, H. H. GRAN, 1902 is included in the above list of synonyms because the specimens on which this statement is based were defined by G. O. SARS, who distinguished between *C. borealis* and *C. maxima* on that occasion.

C. borealis, P. T. CLEVE, 1903 (= *C. b.*, P. T. CLEVE and O. PETTERSSON, 1903) was only included in this list after I had myself subjected the original material to a careful verificatory examination.

It seems to me rather probable that *C. borealis*, V. VÁVRA, 1906 is also identical with this species. Only two specimens were caught by the Plankton Expedition, a mature male and a mature female, both at the same station, in the Labrador current. A number of differences can certainly be noted, e. g. the shape of the female shell, the glands along the posterior margin of the shell (cf. pl. III, fig. 57) and the armature of the d-bristle on the male first antenna. We should also note this author's statement with regard to the sculpture of the shell: „Die Struktur der Schale ist ziemlich fein, aber deutlich, in rhombischen Feldern bestehend.“ This statement seems to support the idea that in these two specimens the sculpture was more weakly developed than in the specimens from the west coast of Scandinavia. What seems in my opinion specially to support the idea of identity with the form dealt with above is the information as to the length of the shell; the male was 2.35 mm., the female 2.9 mm. long, i. e. in this character they agreed very closely with the specimens from Lofoten. A re-examination of these specimens is desirable.

The following statements about finds of this species from the west coast of Norway and from Skager Rak and the North Sea are also presumably to be referred to this species. As, however, they have no verificatory information and as it is not clear whether a distinction has been drawn between *C. borealis* and *C. maxima*, it seemed to me best not to include them in my list of synonyms. These finds are as follows: *C. borealis*, G. O. SARS, 1869, p. 360, O. NORDGAARD, 1898, p. 17, 1905, p. 40, C. H. OSTENFELD, 1906, p. 96 (part.), C. H. OSTENFELD and C. WESENBERG-LUND, 1909, p. 112 (part.), C. APSTEIN, 1911, p. 167 (part.) and E. JÖRGENSEN, 1912, pp. 14, 16.

The name *C. borealis* G. O. SARS is also mentioned in the following places in the literature: G. O. SARS, 1886, p. 75, E. VANHÖFFEN, 1897, p. 285, cf. below, p. 717, C. W. S. AURIVILLIUS, 1898, p. 42, this author 1899, pp. 38, 58 (= P. T. CLEVE, 1900), cf. below p. 717, G. W. MÜLLER, 1901, p. 4, cf. below p. 717, G. H. FOWLER, 1903, p. 121; TH. SCOTT, 1905, p. 228; E. KOEFOED, 1907, pp. 150, 151, 156, 157, 160, 161, 163, 164, 165, 167, 170,

172, 175, 178, 180, 183, 186, 187, 188, 189, 192, 193, 195, 196, 197, 204, 209, 210, 214, 215, 217, 219, 222, 226, 228, 231, 232, 233, 242, 243, 249, 252, 258, 259, 266, 269, 270; D. DAMAS and E. KOEFOED, 1907, p. 381, G. W. MÜLLER, 1912, p. 87 and K. STEPHENSEN, 1913, p. 355.

Habitat: — Skager Rak:

North Koster,; 2. II.; depth, 65 m.: 1 mature male and 3 mature females; R. M. S. 357. South Koster; 1. II.: Depth, 125 m.: 1 mature male; R. M. S. 358. Depth, 140 m.: 5 mature males, 2 mature females and 1 juvenis; R. M. S. 359. — These three samples were taken by the Swedish Hydrographical Biological Commission during a cruise in 1911.

Lat. 58° N., long. 9° E. (= S. VIII.); 9. VIII.: At the surface: 1 mature male; R. M. S. 386. Depth, 300—0 m.: 3 mature females; R. M. S. 385. (= A part of the material of P. T. CLEVE, 1903.)

Coast of Norway:

Lofoten Islands; coll. et det. G. O. SARS: 11 mature males, 78 mature females and 3 juvenes.

Arctic Ocean:

Lat. 76° 36′ N., long. 12° 13′ E.; depth 500—0 m.; 1. VIII. 1898: 1 mature male and 3 mature females; R. M. S. 387 (= *C. b.*, C. W. S. AURIVILLIUS, 1899, p. 62). Lat. 79° 58′ N.*, long. 9° 35′ E.; depth, 400—0 m.; 27. VIII. 1898: 1 mature male; R. M. S. 395 (= *C. b.*, C. W. S. AURIVILLIUS, 1899, p. 66).

Distribution: — West coast of Norway and Skager Rak; Labrador Current, lat. 50° N., long. 48° W. (V. VÁVRA, 1906).

Conchoecia borealis G. O. SARS var. maxima G. S. BRADY and A. M. NORMAN.

Conchoecia maxima, G. S. BRADY and A. M. NORMAN, 1896, p. 686; pl. LXI, figs. 1—8.
„ *borealis*, E. VANHÖFFEN, 1897, p. 285.
„ „ C. W. S. AURIVILLIUS, 1899, pp. 38, 58.
„ „ (part.), P. T. CLEVE, 1900, p. 38.
„ *maxima*, G. O. SARS, 1900, p. 127; pl. XXXV, XXXVI.
„ *borealis*, G. W. MÜLLER, 1901, p. 4, figs. 4—7.
„ *maxima*, H. H. GRAN, 1902, pp. 83, 96, 210.
„ „ P. T. CLEVE, 1903, p. 24.
„ „ C. H. OSTENFELD, 1906, p. 96.
„ „ K. STEPHENSEN, 1913, p. 356.

Description: — See G. S. BRADY and A. M. NORMAN, 1896, p. 686 and G. O. SARS, 1900, p. 127.

Remarks: — The form dealt with here was, as is seen above, established as a special species by G. S. BRADY and A. M. NORMAN in 1896. According to these writers this form is *Relation to C. boreal.*

* Not lat. 78° 58′ N., as is stated in the treatise mentioned.

very closely related to *C. borealis* G. O. SARS — „*C. borealis*, which it very closely resembles". The following differences between these two forms are noted in the work just mentioned: „*C. maxima* is rather larger and the shell is not so densely reticulated. The outline of the shell, seen dorsally, is different, and the spinules of the principal seta of the male antennule are considerably more robust."

G. O. SARS writes (1900, p. 128) with regard to *C. maxima:* „This form is very closely allied to . . . *C. borealis*. It is, however, of larger size, and differs, moreover, in the less strongly marked sculpture of the shell, as also somewhat in the form of the latter. On a closer comparison, some minor differences may also be found to exist in the structure of the several appendages."

G. W. MÜLLER in his work of 1901 put forward the view that the two forms are quite identical; the same view is also taken by this writer in his later works, 1906 a, p. 111 and 1912, p. 87. This view has been adopted by P. T. CLEVE, 1903 and V. VÁVRA, 1906. Other writers have, as we have seen above, accepted the species established by G. S. BRADY and A. M. NORMAN.

Which of these opinions is the correct one? Are these two forms quite identical or not?

It seems to me impossible at present to answer this question with complete certainty. To do this it would be necessary to carry out renewed and careful investigations on a considerably more abundant material than that which was at my disposal. At present it seems to me most probable that *C. maxima* is not quite identical with *C. borealis*. The differences between the forms in question are, however, so small that it seemed to me to be best to put the former as a variety of the latter.

The only quite certain difference I was able to find was that of size. G. O. SARS states that the male of *C. maxima* had a shell 3.20 mm. long and the female 3,50 mm. G. W. MÜLLER's males from Greenland measured 3.0—3.15 mm. The males of the *maxima* form investigated by me had shells 2.95—3.2 mm. long; the females were 3.25—3.5 mm. long. The difference between these figures and those previously given for *C. borealis* is, of course, striking. The maximum length for the latter species is ♂ 2.35 (V. VÁVRA), ♀ 2.9 mm. May this difference in size be connected with a difference in locality? Is the increase in size not merely the result of a modification under Arctic conditions? This explanation, which may, of course, seem a priori exceedingly probable, is very decidedly opposed, however, by the fact that I found a typical mature *C. borealis* male as far north as lat. 79° 58′ N.; the length of shell of this male was not greater than that of the specimens from Lofoten; cf. p. 708 above. At lat. 76° 36′ one mature male and three mature females were found, all typical *C. borealis*; the male measured, as is seen above, 2.3 mm., the females 2.4—2.7 mm., i. e. the latter were even somewhat smaller than the Lofoten specimens. It was these finds especially that caused me not to follow G. W. MÜLLER's example of uniting these two forms entirely.

The posterior edge of the shell of the mature male is in most cases somewhat less rounded in the *maxima* form than in the *borealis* form; cf. pl. XXXV, fig. 3, G. O. SARS, 1900 and my appended fig. 1; there is, however, not quite complete constancy with regard to this character. The shoulder vault of the shell is, in both males and females of the *maxima* form, somewhat less developed than in *borealis*. On account of this the shell, when seen from the side, gets a straighter dorsal margin in the former form; see G. O. SARS's figs., 1900 and G. W. MÜLLER's

fig., 1901. In a number of the female* specimens of *maxima* investigated by me the shoulder vault was rounded, in others it was more or less distinctly sharp-edged. The sculpture of the shell in the *maxima* form is, as G. O. SARS pointed out, weaker than in *borealis*, but this character too is subject to some variation. (On the other hand I was unable to discover any difference in the deneness of the reticulation such as G. S. BRADY and A. M. NORMAN pointed out. Nor was I able, like these writers, to find any distinct difference between the two forms with regard to the type of the shell as seen from above.)

An exceedingly minute investigation of the other organs of these two forms did not confirm G. O. SARS's supposition that additional differences exist. Thus, unlike G. S. BRADY and A. M. NORMAN, I was unable to find any difference with regard to the strength of the spines on the e-bristle of the male first antenna. There is, however, possibly a difference in the number of these spines; in the *maxima* specimens investigated by me there were only 44—49 spines in each row, while in the *borealis* specimens, as is seen above, there were 50—55.

That *C. borealis*, E. VANHÖFFEN, 1897 (= *C. b.*, G. W. MÜLLER, 1901) is identical with the *maxima* form is shown with all desirable clearness by G. W. MÜLLER's description and figures. Synonym

The identity of *C. borealis*, C. W. S. AURIVILLIUS, 1899, pp. 38 and 58 (= part. P. T. CLEVE, 1900) was verified by myself on a re-examination of the original material; cf. below. — *C. borealis*, C. W. S. AURIVILLIUS, 1899, pp. 62 and 66 proved, on the contrary, after a verificatory investigation carried out by me, to be typical *borealis* forms; cf. p. 715 above.

Although *C. maxima*, H. H. GRAN, 1902, P. T. CLEVE, 1903 and C. H. OSTENFELD, 1906 are not accompanied by any verificatory information, it seemed to me justifiable, all the same, to include them in the list of synonyms given above.

C. maxima, G. S. BRADY, 1902 a, p. 199 (= the same author 1903, pp. 337, 338 and A. M. NORMAN 1905, p. 155) is, on the other hand, not included in this list, as these authors themselves point out the uncertainty of the determinations by adding a query.

C. maxima, G. H. FOWLER, 1897, p. 523 and 1903, p. 121 are not followed by any descriptions or verificatory drawings; under these circumstances it did not seem convenient to me to include these names in the list of synonyms given above.

Habitat: — Arctic Ocean:

Lat. 66° 53′ N., long. 2° 52′ W.; depth, 500—0 m.; 5. VI. 1899: 6 specimens; R. M. S. 388. Lat. 71° 30′ N., long. 21° W.; depth, 200—0 m.; 27. VII. 1899: 1 mature female; R. M. S. 389. Lat. 77° 39′ N., long. 1° 18′ E.; depth, 500—0 m.; 26.—27. VII. 1898: 15 specimens; R. M. S. 390. Lat. 77° 52′ N., long. 3° 5′ W.; depth, 500—0 m.; 29. VII. 1898: 14 specimens; R. M. S. 391. Lat. 78° 13′ N., long. 2° 58′ W.; 29.—30. VII. 1898: Depth, 100—0 m.: 1 juvenis; R. M. S. 392. Depth, 500—0 m.: 10 specimens; R. M. S. 393. Depth, 2600—0 m.: 50 specimens; R. M. S. 394. (= A part of the material of C. W. S. AURIVILLIUS, 1899 = P. T. CLEVE, 1900.)

The statements as to how many specimens of this form were caught at each of the above-mentioned stations are taken from an unpublished manuscript of Professor J. G. ANDERSSON.

* Cf. G. W. MÜLLER, 1912, p. 87.

the investigator who collected the material in question during the „A n t a r c t i c" expedition and on whose determinations C. W. S. AURIVILLIUS and P. T. CLEVE based their information. A large part of this material has unfortunately been lost; there are, however, one or more specimens preserved from each of the stations in question, so that the statements as to identity can be verified.

Distribution: — North Atlantic Ocean and Arctic Ocean between lat. 60° N. (G. S. BRADY and A. M. NORMAN, 1896) and lat. 84° N. (G. O. SARS, 1900); Baffin Bay (Karajak Fjord, lat. 70° N., E. VANHÖFFEN, 1897).

Conchoecia borealis G. O. SARS var. antipoda G. W. MÜLLER.

Conchoecia antipoda, G. W. MÜLLER, 1906 a, p. 110; pl. XXVI, figs. 5—16.
„ „ „ „ „ 1908, p. 75.
„ „ „ „ „ 1912, p. 87.

Description: — See G. W. MÜLLER, 1906 a, p. 110.

Supplementary description: — M a l e: —

S h e l l: — Length: According to G. W. MÜLLER, 2,8—2,95 mm. Both the specimens investigated by me measured 2,8 mm. The shape was quite or at any rate almost quite the same as in *C. borealis*. Thus the shoulder vault had a sharp edge, contrary to what is stated by G. W. MÜLLER, 1906 a; males and females are alike in this respect (a variable character?). The posterior margin of the shell too is about the same as in the form just mentioned and, as is the case in this form, it varies to some extent. The sculpture is of the same type as in *C. borealis*, but is rather considerably weaker; with suitable manipulation it is visible on the whole surface of the shell; it varies somewhat in strength. In other respects the shell is like that of *C. borealis*.

With regard to o t h e r c h a r a c t e r s this form agrees with *C. borealis*, with the exception of the d-bristle on the male first antenna, which is of about the type reproduced in G. W. MÜLLER's pl. XXVI, fig. 9; on the e-bristle of this limb there were only 40 to 44 spines in each row in the specimens investigated by me.

Fig. CXXXVII. — *Conchoecia borealis* G. O. SARS var. *antarctica* G. W. MÜLLER. ♂. 1. Distal part of the rod-shaped organ + 1. part of the first antenna. 170 ×. From a specimen from station 64 b.

F e m a l e: —

S h e l l: — Length: According to G. W. MÜLLER, 3,15—3,3 mm. The specimens investigated by me measured 3,0—3,2 mm. Seen from the side it is

relatively somewhat higher posteriorly, but otherwise it is of about the same type as in the male. Seen from below it is of the same shape as in *C. borealis*.

In the case of the other organs it agreed with *C. borealis*.

Relation to C. borealis.

Remarks: — As is seen above, this form is looked upon by G. W. MÜLLER as a special species. It seemed to me, on the contrary, best to put it as a variety of *C. borealis* G. O. SARS. The differences that distinguish it from this form — the length and sculpture of the shell, the number of spines on the e-bristle of the male first antenna and the armature on the d-bristle of this limb — are so small that they seem to me to form an adequate argument in favour of this alteration; cf., for instance, the difference between *C. obtusata* G. O. SARS and its variety *antarctica*.

G. W. MÜLLER puts forward (1906 a, p. 111) a number of other differences between these two forms besides those pointed out above. The explanation of this is probably partly that this writer had only *maxima* forms of *C. borealis* at his disposal and partly also his somewhat deficient knowledge of this form.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth, 2500—0 m.; 23. VI. 1902: 2 mature males, 16 mature females and 12 juvenes; R. M. S. 305, 306. S. A. E., Pl. station 70 b, lat. 49° 56′ S., long. 49° 56′ W.; depth, 2700—0 m.; 27. VI. 1902; temperature at 2700 m. and at the surface, + 1,67° C. and 3,40° C. resp.: 5 mature females and 4 juvenes; R. M. S. 307.

Distribution: — South Atlantic Ocean and Antarctic Ocean between lat. 1° S. and lat. 65° S.

The finds of the „Antarctic“ are consequently made within the area of distribution stated by G. W. MÜLLER.

Imbricata group G. W. MÜLLER

(*Conchoecissa* C. CLAUS)*.

This group, comprising five species, is certainly quite natural. I cannot say with certainty whether *C. prosadene* G. W. MÜLLER belongs to it; it seems probable that it is not closely related to these species.

Conchoecia symmetrica G. W. MÜLLER.

Conchoecia symmetrica, G. W. MÜLLER, 1906 a, p. 117; pl. XXVII, figs. 7, 8, 13, 15, 16.
„ „ „ „ „ 1908, p. 78.
„ „ „ „ „ 1912, p. 90.

* G. O. SARS suggested as early as 1887 that „*Halocypris imbricata* G. S. BRADY“ should be broken out as a special genus, but all the same he did not make this himself.

Description. — See G. W. MÜLLER, 1906 a, p. 117.

Supplementary description: — Male: —

Shell: — Length: According to G. W. MÜLLER 3,7—4,1 mm.; my specimens measured 4,0—4,25 mm. Length : height about 2,1 : 1; length : breadth about 2,4 : 1. Seen from the side (see fig. 1) it is of about the same type as in *C. plinthina* G. W. MÜLLER. It differs from this in the following respects. The anterior part of the dorsal margin is partly

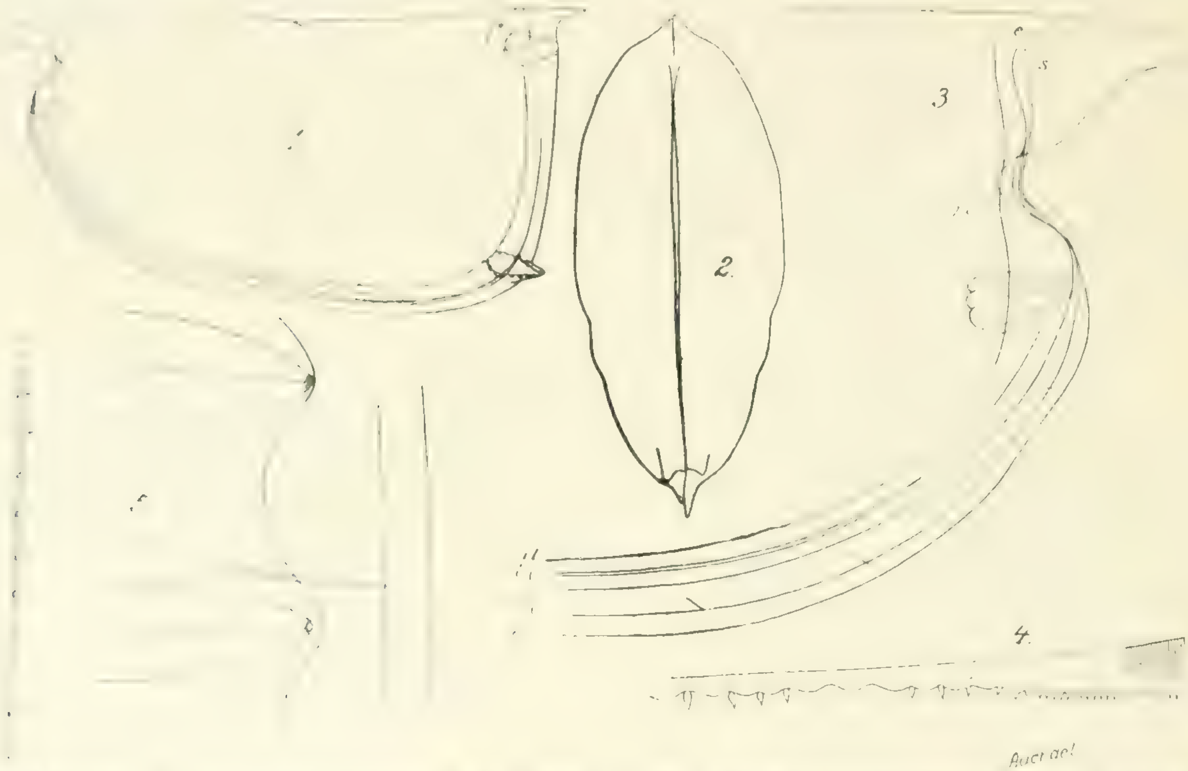

Fig. CXXXVIII. *Conchoecia symmetrica* G. W. MÜLLER, ♂. — 1. Shell seen from the side; 19 ×. 2. Shell seen from below; 16 ×. 3. Anterior part of the left valve seen from inside; 39 ×. 4. A part of the selvage just inside the lateral corner gland; 85 ×. 5. A part of the posterior margin of the shell seen from inside; 567 ×. (From specimens from station 64 b.)

covered by the shoulder vault. The ventral margin is somewhat, though only rather slightly, concave. The lateral corner glands have their exits on a large conical peg, which is of about the same size and type on both valves and which extends rather considerably beyond the margin of the shell. The processes at the postero-dorsal corner of the shell are somewhat, though only rather slightly, shorter. Seen from below it has its greatest breadth at about the middle and the anterior part somewhat larger than the posterior part. The side contours are rather evenly curved except just behind the middle, where they undulate rather weakly. Both the back and front ends are pointed; the rostral process on the left valve is only slightly larger than that on the right valve; see the appended fig. 2. The shoulder vault is well developed and is rounded. For the sculpture see G. W. MÜLLER. The surface of the shell has a very

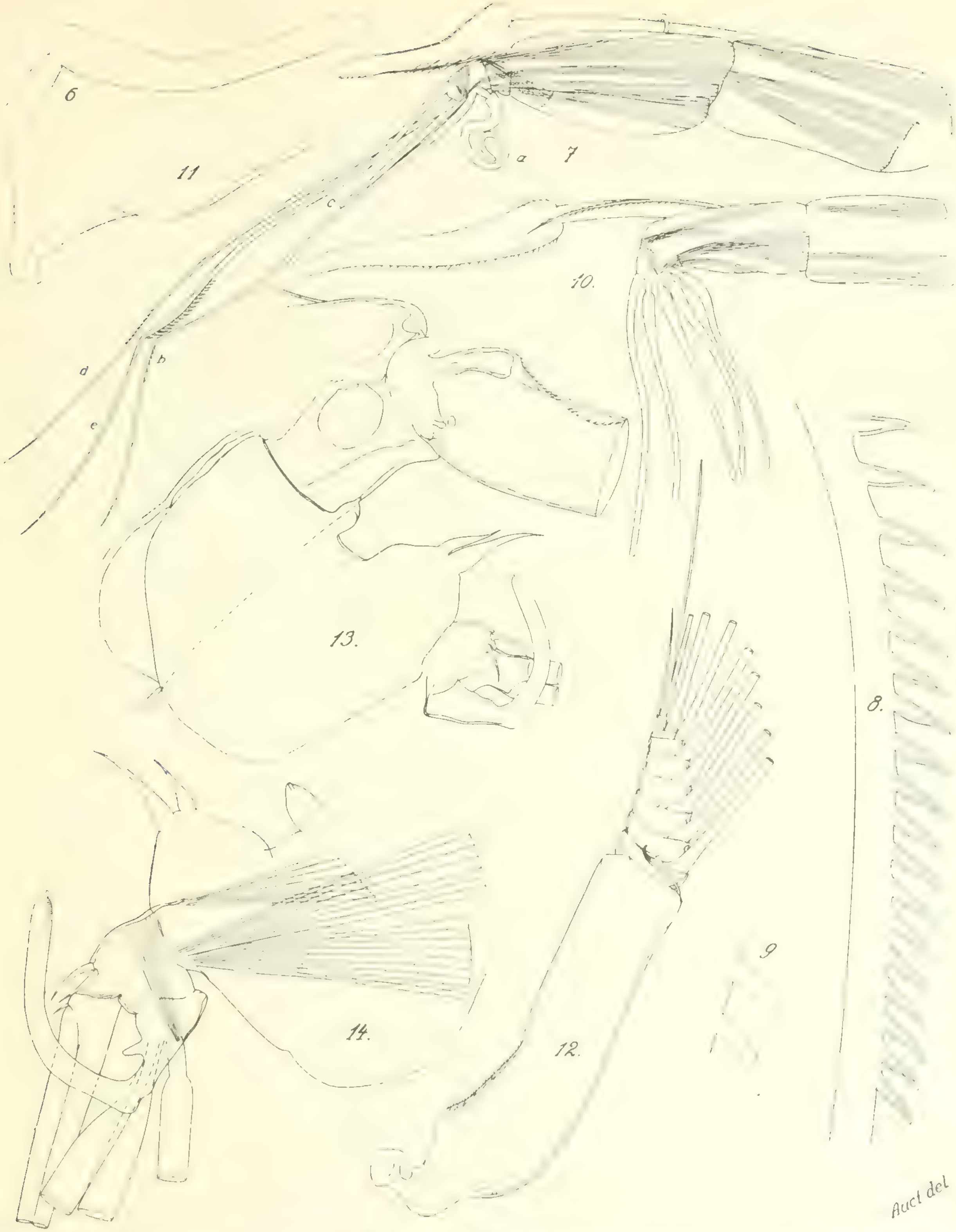

Fig. CXXXIX. — *Conchoecia symmetrica* G. W. MÜLLER. — 6. Distal part of the rod-shaped organ, ♂; 99 ×. 7. Left first antenna + the rod-shaped organ, ♂; 58 ×. 8. A part of the e-bristle of the first antenna, ♂; 450 ×. 9. Two of the spines of this bristle, compressed; 450 ×. 10. Left first antenna + the rod-shaped organ; the e-bristle of the antenna is broken, ♀; 75 ×. 11. Distal part of the protopodite of the second antenna seen from outside, ♂; 99 ×. 12. Exopodite of the right second antenna seen from inside, the long bristles are broken, ♀; 99 ×. 13. Distal part of the protopodite + the proximal part of the exopodite and the endopodite of the left second antenna seen from inside; the end bristles of the endopodite are broken, ♂; 131 ×. 14. Endopodite of the right second antenna seen from inside, the end bristles are broken, ♂; 131 ×. (From specimens from station 64 b.)

few scattered moderately long or short bristles. The glands are as described by G. W. MÜLLER for *C. plinthina*; just ventrally of the rostral incisur there is on both valves a group of several large lateral glands. Seen from inside: Selvage (see the appended figs. 3, 4, 5): This is of the same type as is described above for *C. borealis*. There is no distinctly developed hinge-socket or hinge-tooth at the posterior dorsal corner of the shell.

First antenna (see the appended fig. 7): — E-bristle: This is somewhat longer than this limb and is bent at a decided angle at or somewhat proximally of two thirds of its length. Just proximally of this bend there are two well separated rows of strong, smooth spines, pointing somewhat proximally; there are about seventeen or eighteen spines in each row (see the appended fig. 8). The spines in these rows are either placed in pairs or else there is weak or even complete alternation. The distance between the distal spines is about as great as or somewhat more than the width of these spines at the base; the proximal ones are situated somewhat closer together than the distal ones. All the spines are of the same type; the distal ones are, however, somewhat larger than the proximal ones; seen from the side they are bent somewhat proximally and are pointed; if they are strongly compressed they appear to be flattened and somewhat rounded or more or less abruptly cut off distally; see the appended fig. 9. Otherwise this bristle is quite bare. Distally of the rows of spines it is slightly sword-shaped. The b- and d-bristles are subequal, either about as long as the e-bristle or somewhat shorter (sometimes somewhat shorter than in the appended fig. 7). The b-bristle, or else both these bristles, are bent at a distinct angle at about the corresponding place as the e-bristle. Both have about opposite the spines of the e-bristle a varying number (from about 5—25 were observed) of short, weak, distally pointing secondary bristles. Distally these bristles are narrow or at any rate only very slightly sword-shaped; both of them are without any pad-like appendages. The a- and c-bristles are subequal, about a quarter of the length of the the e-bristle; the c-bristle is straight, the a-bristle more or less rolled up; the a-bristle has a more or less weakly developed accessory saccule. All the joints are quite bare.

Second antenna: — Protopodite (see the appended figs. 11 and 13): In specimens with shells 4,0—4,1 mm. long this limb measured 1,6—1,7 mm. Exopodite (see the accompanying fig. 12): The proportion between the length of this branch and that of the protopodite is about 11 : 20. The proportion between the length of the first joint and the total length of the eight following joints is about 10 : 4—5. The proportion between the length of the longest natatory bristles and that of this branch is about 15—17 : 10. The first joint is furnished proximo-dorsally with a single dense longitudinal row of short, fine spines along about a quarter or a third of the length of this joint and close to this row there are a rather large number of scattered spines of the same kind and size. Endopodite (see the appended figs. 13 and 14): First joint: The processus mammillaris has a small distal verruca. The a- and b-bristles are bare. Second joint: The c- and d-bristles are not inconsiderably shorter than this joint and are bare. The e-bristle is short. The g-bristle is about one and a half times the length of the protopodite; the f-bristle is about a quarter shorter. Both these bristles are weakly sword-shaped distally; the g-bristle has short hairs, the f-bristle is often bare. End joint: Clasping organs: These are of the types reproduced by G. W. MÜLLER. The right organ may sometimes

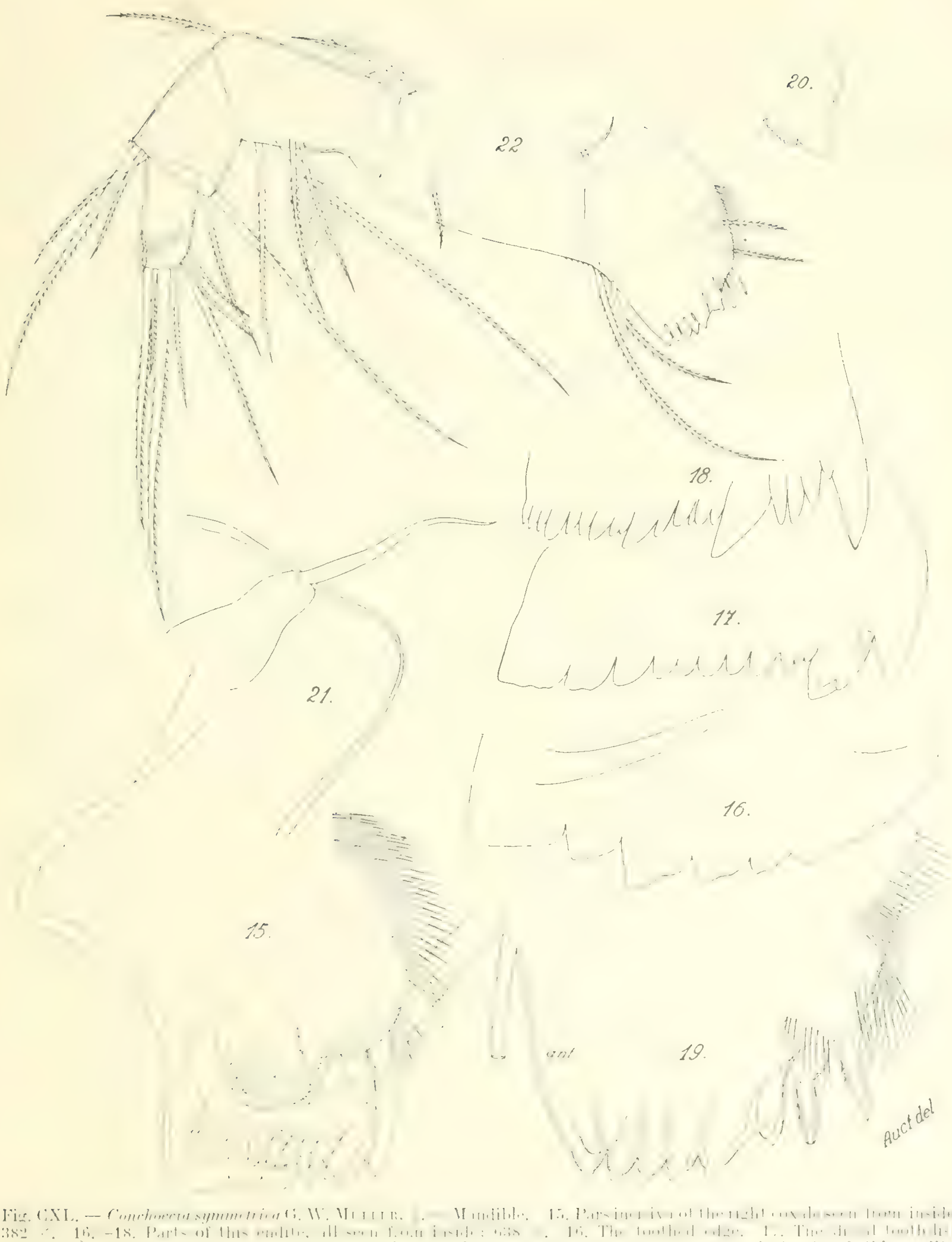

Fig. CXL. — *Conchoecia symmetrica* G. W. MUELLER. 15.—22. Mandible. 15. Pars incisiva of the right coxale seen from inside; 382 ×. 16.–18. Parts of this endite, all seen from inside; 638 ×. 16. The toothed edge. 17. The distal tooth-list. 18. The proximal tooth-list. 19. Endite of the left basale seen from outside; 292 ×. 20. A tooth of this endite: 638 ×. 21. The proximo-medial ridge of the basale + the epipodial appendage; 472 ×. 22. Right mandible (except the coxale), seen from inside; 82 ×. (From specimens from station 64 b.)

have a small verruca somewhat distally of the basal verruca. Both the right and the left organ have an exceedingly small papilla distally and are weakly cross-grooved distally; the right organ is, in addition, furnished distally with some short spines and hairs. The h-, i- and j-bristles are most frequently subequal, about as long as the exopodite and bare; the h-bristle has a short but sharply marked shaft; the i- and j-bristles have a somewhat longer shaft, but one that is only very weakly or not at all defined. Just distally of the shaft these three bristles are about as thick as the g-bristle is proximally.

Fig. CXLI. — *Conchoecia symmetrica* G. W. Müller. — Maxilla. 23. Endite of the left procoxale seen from inside-behind, ♀; 567 ×. 24. Endite of the right coxale seen from outside-behind, ♂; 567 ×. 25. Left endopodite + basale seen from inside, ♂; 139 ×. 26. Distal part of a bristle on the posterior side of the first endopodite joint, ♀; 833 ×. (From specimens from station 64 b.)

M a n d i b l e (see the appended fig. 22): — P r o t o p o d i t e: Coxale (see the appended fig. 15): The toothed edge of the pars incisiva has about ten teeth (see the appended fig. 16). Distal tooth-list: This is of the same type as is described above for *C. oblonga* and has from about twelve to sixteen teeth (see the appended fig. 17). Proximal tooth-list: This is rather slightly narrower than the distal one and varies somewhat in type. It consists of about 10 to 25 irregularly arranged smooth conical teeth which vary in size and strength; some of the posterior ones are almost as large as the two posterior ones on the distal tooth list; see the accompanying fig. 18. On the inside this list is furnished with fine, short spines, situated close together. The masticatory pad is rather narrow and high, somewhat more than half the width of the tooth-lists, and is divided into four or five transverse ridges; it is armed with short, fine papillae, placed close together. The part that is surrounded by the row of bristles and hairs is raised somewhat like a pad and is also furnished with short, fine papillae, placed close together. Basale: The six teeth on the distal edge of the endite are furnished with rather fine serrulation (see the appended figs. 19 and 20). The single tooth on the outside of this process is of about the type reproduced in the figure just mentioned. The e p i p o d i a l a p p e n d a g e consists of a moderately large verruca with a moderately long bristle; see the appended fig. 21. E n d o p o d i t e: The first joint has four bristles on the posterior side; one of these is situated somewhat laterally and is about as long as this branch. The three others are situated more or less medially and are about half the length of the former bristle or a little shorter or longer; one of these three bristles usually has long hairs, the others have short hairs. Pilosity: The basale is furnished medio-ventrally with moderately long and rather sparse hairs.

Fig. CXLII. – *Conchoecia symmetrica* G. W. Müller, ♂. 27. Left fifth limb seen from outside: 114 ×. 28. Distal part of the middle end claw of this limb; 938 ×. (From a specimen from station 64 b.)

M a x i l l a (see the appended figs. 23—26): — The end joint of the endopodite is relatively long, about the same length as in *C. borealis*.

F i f t h l i m b: — This is of about the same type as in my fig. 27. P r o t o p o d i t e: The longer of the two tube-bristles on the second endite has long secondary bristles. E n d o p o d i t e: One of the three ventral anterior bristles is of about the same length and type as the long bristle on the first endite. The two others are somewhat shorter; one of them has short hairs, the other usually has rather long secondary bristles. On the outside the endopodite is furnished anteriorly with a number of short spines. E x o p o d i t e: First joint: The ventero-medial group has two bristles, the proximo-ventral one has four or five bristles and the disto-ventral one three or four bristles. One or two of the proximo-ventral ones and the same number of the disto-ventral ones are usually furnished at the middle with long hairs. This limb is sometimes bare, sometimes the protopodite and the first exopodite joint are partly furnished with moderately long hairs.

S i x t h l i m b (see the appended fig. 29): — The ventral bristle on the end joint has short hairs.

S e v e n t h l i m b: — The end joint has spines; see the appended fig. 31.

P e n i s: — This is of about the type reproduced in the appended fig. 32. It has about six to eight oblique transverse muscles at the middle, distally of which there are no muscles. The copulatory appendage is well developed and varies somewhat in type; in most cases it is rather wide and rounded as in the figure just mentioned.

F u r c a (see the appended figs. 33 and 34): — Behind the claws there is an unpaired short-haired bristle, about as long as the sixth or seventh claw.

R o d - s h a p e d o r g a n: — The shaft reaches to about the distal boundary of the second joint of the first antenna or to the point of this limb. The capitulum (see the appended figs. 6 and 7) is of about the type reproduced by G. W. MÜLLER, about as long as or somewhat shorter than the second joint of the first antenna.

U p p e r l i p (see the appended figs. 35—37): — The part between the combs on the postero-ventral edge of this lip is only slightly concave in the middle. The p a r a g n a t e s are of about the type reproduced in the appended fig. 38.

F e m a l e: —

S h e l l: — Length: According to G. W. MÜLLER, 4,1—4,4 mm. Of the specimens investigated by me one (abnormal) measured 4,0 mm., 32 were 4,4—4,6 mm. and one was 4,7 mm. long. S e e n f r o m t h e s i d e it is almost entirely of the same type as the male shell; it differs by having the rostrum somewhat longer and perhaps somewhat straighter and by being in most cases relatively somewhat higher posteriorly. S e e n f r o m b e l o w it is also of about the same type as in the male, but the anterior part is not or is at least scarcely perceptibly larger than the posterior part and the side contours are more evenly curved.

F i r s t a n t e n n a (see the appended fig. 10): — The division into joints is fairly distinct. The dorsal bristle on the second joint is about as long as the a—d-bristles and has short hairs. The e-bristle is about twice as long as this limb; it is only slightly sword-shaped distally and its anterior side is bare. The a-b-c-d-bristles are subequal, about a third of the length of the

Fig. CXLIII. — *Conchoecia symmetrica* G. W. Müller. — 29. Right sixth limb (without the epipodial appendage) seen from outside, ♂: 58 ×. 30. Left sixth limb (without the epipodial appendage) seen from outside, : 115 ×. 31. Seventh limb, ♀: 82 ×. 32. Penis seen from outside, 150 ×. (From specimens from station 64 b.)

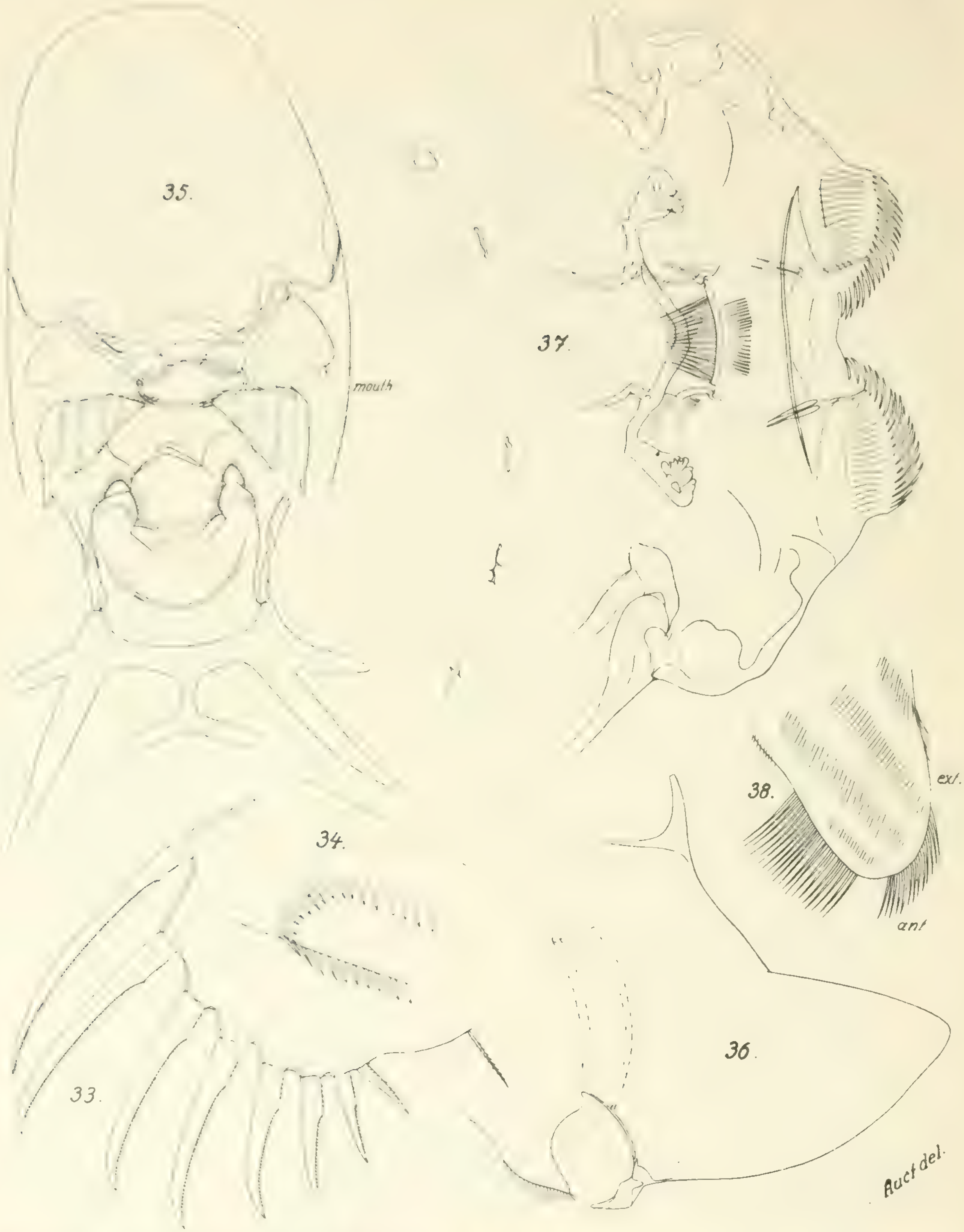

Fig. CXLIV. [illegible] G. W. Mueller. — 33. Furca, [illegible] 84 [illegible]. 34. Proximal part of the second furcal claw. ♀; 638 ×. 35. The upper and under lips seen from beneath, ♀; 116 ×. 36. The upper lip and the right paragnate seen from the side, ♂; 99 ×. 37. The posterior part of the upper lip seen from above, ♀; 292 ×. 38. Paragnate seen from below, ♂; 292 ×. (From specimens from station 64 b.)

e-bristle. The first and second joints are partly furnished with fine spines. These joints have yellowish-brown corpuscles.

Second antenna: — The protopodite is rather slightly weaker than in the male. The exopodite is relatively somewhat shorter than in the male, but is otherwise the same. Endopodite: This is rather distinctly three-jointed. The f- and g-bristles are of about the same type and relative size as in the male or only rather slightly shorter. The h-, i- and j-bristles are in most cases relatively somewhat shorter than in the male; in most cases they have no distinct shafts and are furnished proximally with short, fine spines. The f-bristle too is furnished with short hairs more often than in the case of the male. Between the h- and i-bristles there is sometimes an exceedingly small papilla, but in most cases it is quite absent. The second endopodite joint is bare.

Rod-shaped organ: — The stem extends in most cases about as far as half the length of the capitulum beyond the point of the first antenna. The capitulum is of the type described by G. W. MÜLLER (see the accompanying fig. 10) and is about one and a half times or twice as long as the second joint of the first antenna.

Remarks: — The larvae investigated by me belonged to Stages I—III. They measured 3,05—3,3 mm., 2,05—2,2 mm. and 1,3—1,35 mm.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 34 b, lat. 46° 45′ S., long. 58° 2′ W.; depth, 700—500 m.; 28. XII. 1901: 1 juvenis of Stage III. S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth, 2500—0 m.; 23. VI. 1902: 24 mature males, 43 mature females and 54 juvenes; R. M. S. 308—311. S. A. E., Pl. station 70 b, lat. 49° 56′ S., long. 49° 56′ W.; depth, 2700—0 m.; 27. VI. 1902; temperature at 2700 m. and at the surface, + 1,67° C. and 3,40° C. resp.: 3 mature males, 1 mature female and 14 juvenes; R. M. S. 312.

Distribution: — South Atlantic Ocean and Antarctic Ocean between the equator and lat. 54° S. Indian Ocean.

The three stations of the „Antarctic" expedition are consequently situated within the area of distribution stated by G. W. MÜLLER.

Alata group G. W. MÜLLER.

With regard to this group I hold quite the same view as has been put forward by G. W. MÜLLER, 1906 a, p. 121. It may be taken as quite certain that *C. Belgicae* belongs to it.

Conchoecia hettacra G. W. MÜLLER.

Conchoecia hettacra, G. W. MÜLLER, 1906 a, p. 121; pl. XXIX, figs. 11—19.
„ „ „ „ „ 1906 c, p. 4.
„ „ „ „ „ 1908, p. 78.
„ „ „ „ „ 1912, p. 92.

Description: — See G. W. MÜLLER, 1906 a, p. 121.

Supplementary description: — Male: —

Shell: — Length: According to G. W. MÜLLER 1,9 mm. „Größe ziemlich konstant". The specimens investigated by me measured 1,8—1,9 mm. Length : height about 2 : 1; length : breadth about 2,1 : 1. Seen from the side it is of about the type reproduced by G. W. MÜLLER. Seen from below (see the appended fig. 1) it has its greatest width at or just in front of the middle and the anterior part rather considerably larger than the posterior part. The side contours are evenly curved, but have a rather marked sinuation just behind the middle. It is broadly rounded anteriorly with a symmetrical rostrum and is pointed posteriorly. The shoulder vault is rather well developed, with a somewhat sharp edge or rounded. The surface of the shell is bare and its sculpture is of the type described by G. W. MÜLLER. Seen from inside: Selvage: This is smooth on the rostrum just as it is along the anterior margin of the shell and the anterior half of the ventral margin of the shell; there is no spine-like process on the rostrum. Along the posterior half of the ventral margin it is finely serrulated, along the posterior margin of the shell it has coarse, irregular serrulation; see the appended fig. 5 (♂ = ♀). The compound glands are as described by G. W. MÜLLER. The medial glands along the posterior margin of the shell are of about the same type as is described for *C. oblonga* on p. 618 above, but some of them are joined by a rather distinct list. At the posterior dorsal corner there is a well developed, elongated hinge-socket and hinge-tooth; see the appended fig. 4 (♂ = ♀).

First antenna: — This is of the type described and reproduced by G. W. MÜLLER. E-bristle: This has a double row of five or six „stempelartigen Zapfen"; these „Zapfen" are of about the same type as is shown on p. 699 above for *C. spinirostris*; see the appended fig. 6. Along the proximal half this bristle has on its anterior side a moderate number of rather short hairs; it is narrow distally. The equipment of the b- and d-bristles agrees with that stated by G. W. MÜLLER; these bristles are narrow distally and have no pad-like appendages. The a-bristle has an accessory saccule. All the joints are quite bare.

Second antenna: — Protopodite: Length about 0,9 mm. Exopodite: The proportion between the length of this branch and that of the protopodite is about 16—17 : 30. The proportion between the length of the first joint and the total length of the eight following joints is about 10 : 4. The proportion between the length of the longest natatory bristles and that of this branch is about 5 : 3. The armature of the first joint is about the same as in

C. symmetrica. E n d o p o d i t e: First joint: The processus mammillaris has no distal papilla. The a- and b-bristles have short hairs or are almost bare. Second joint: The c- and d-bristles are not inconsiderably shorter than this joint and are bare. The e-bristle is rather short. The g-bristle is most frequently somewhat longer, the f-bristle somewhat shorter, than the protopodite; neither of them is sword-shaped distally and both have a few short hairs. Third joint: The clasping organs are as described by G. W. MÜLLER. The h-, i- and j-bristles are subequal and about as long as or somewhat shorter than the first joint of the exopodite; the h-bristle has, at least in some cases, signs of a shaft, the others have no distinct shaft; they are narrow, almost only half as wide as the proximal width of the g-bristle, and are bare.

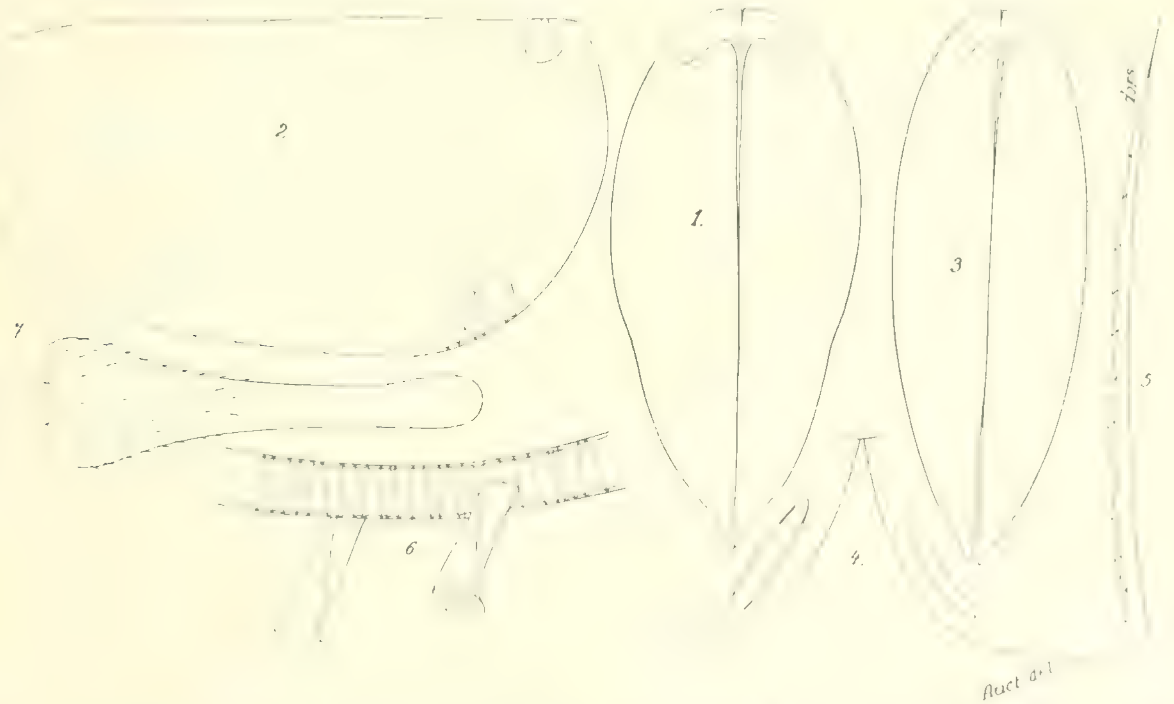

Fig. CXLV. *Conchoecia hettacra* G. W. MÜLLER. 1. Shell seen from below, ♂, 40 ×. 2. Shell seen from the side, ♀; 42 ×. 3. Shell seen from below, ♀; 34 ×. 4. Postero-dorsal part of the shell seen from inside, ♀, 300 ×. 5. A part of the selvage inside the posterior margin of the shell, ♀; 833 ×. 6. A part of the e-bristle of the first antenna, ♂; 1200 ×. 7. Distal part of the rod-shaped organ seen from below, ♂, 187 ×. (From specimens from station 58 b.)

M a n d i b l e: — This limb agrees almost entirely with the same limb in *C. symmetrica.* The toothed edge on the pars incisiva has from about ten to thirteen teeth. In most cases all the four bristles on the posterior side of the first endopodite joint have short hairs.

M a x i l l a: — The end joint is comparatively long, about the same type as in *C. borealis.*

F i f t h l i m b: — About the same as in *C. symmetrica.* Of the three antero-ventral bristles on the e n d o p o d i t e both the two shorter ones usually have short hairs. The endopodite has no spines. There are one or two ventero-medial bristles on the first e x o - p o d i t e joint.

Sixth limb: — Endopodite: This has one or two bristles, which are sometimes furnished with short hairs, sometimes with long ones. Exopodite: First joint: At about the middle of the ventral side there are one or two bristles, one of which is rather long and has long hairs and the other usually short and with short hairs. Disto-ventrally there are two or three bristles, all of which are usually rather short and have short hairs. The two dorsal bristles on this joint are also short and have short hairs. Sometimes all the bristles on this joint have short hairs.

Penis: — This is of about the same type as in *C. symmetrica*, but the copulatory appendage is considerably narrower, about as narrow as in *C. Haddoni*.

Furca: — Behind the claws there is an unpaired bristle, which is about as long as the sixth or the seventh claw.

Rod-shaped organ: — The shaft reaches to about the distal boundary of the second joint of the first antenna or to the point of this limb. The capitulum (see the appended fig. 7) is about as long as or somewhat shorter than the second joint of the first antenna and is of about the type reproduced by G. W. MÜLLER.

Upper lip: — The part between the combs is of about the same type as in my fig. 4 of *C. Belgicae*. The paragnates are about the same as in *C. symmetrica*.

Female: —

Shell: — Length: According to G. W. MÜLLER 2.35 mm. The specimens investigated by me measured 2.0–2.25 mm. Length : height about 2 : 1; length : breadth about 2,8 : 1. Seen from the side (see the appended fig. 2) it is of about the same type as the male shell, but is somewhat higher posteriorly. Seen from below it has its greatest width at about the middle and the anterior part dominates somewhat less over the posterior part; the side contours are evenly curved; see fig. 3. In other respects it is like that of the male.

First antenna: — This has rather distinct joints. The bristle on the second joint is about as long as the capitulum on the rod-shaped organ and has short hairs. The e-bristle is not quite twice as long as this limb and has on its anterior side a similar equipment to that of the male; it is not sword-shaped distally. The a- to the d-bristles are subequal and about a third of the length of the e-bristle. The first and second joints are partly furnished with short, fine spines.

Second antenna: — The protopodite is somewhat weaker than in the male; it attains a length of about 0.9 mm. in specimens whose shells are 2,15 mm. long. Exopodite: The proportion between the length of this branch and that of the protopodite is about 17 : 30. Endopodite: This has two joints. The g-bristle is not quite so long as the protopodite, the f-bristle is about a third or a quarter shorter; otherwise they are like those of the male. The h-, i- and j-bristles are about half as long as the g-bristle or somewhat shorter or longer; they have sparse short hairs. The second joint is bare.

Rod-shaped organ: — The shaft extends to about the point of the first antenna. The capitulum is of the type reproduced and described by G. W. MÜLLER.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 34 b, lat. 46° 45′ S., long. 58° 2′ W.; depth 700—500 m.; 28. XII. 1901: 1 mature male and 1 mature female; R. M. S. 313. S. A. E., Pl. station 70 b, lat. 49° 56′ S., long. 49° 56′ W.; depth 2700—0 m.; 27. VI. 1902; temperature at 2700 m. and at the surface + 1,67° C. and 3,40° C. resp.: 1 mature female and 1 juvenis; R. M. S. 319. S. A. E., Pl. station 60 b, lat. 52° 39′ S., long. 37° 35′ W.; depth 500—0 m.; 17. VI. 1902; temperature at 500 m. and at the surface + 1,35° C. and + 0,50° C.: 2 mature females and 4 juvenes; R. M. S. 317. S. A. E., Pl. station 61 b, at the same locality; depth 2000—0 m.; 17. VI. 1902; temperature at 2000 m. + 1,30° C.: 1 mature female; R. M. S. 318. S. A. E., Pl. stations 318 and 59 b, lat. 53° 0′ S., long. 48° 27′ W.; depth 500—0 m.; 17. IV. 1902; temperature at 500 m. and at the surface + 1,50° C. and 3,40° C. resp.: 4 mature males, 8 mature females and 3 juvenes; R. M. S. 316 and 320. S. A. E., Pl. station 58 b, at the same locality; depth 250—0 m.; 17. IV. 1902; temperature at 250 m. + 1,30° C.: 3 mature males, 10 mature females and 2 juvenes; R. M. S. 315. S. A. E., Pl. station 57 b, at the same locality; depth 100—0 m.; 17. IV. 1902; temperature at 100 m. + 3° C.: 1 mature female; R. M. S. 314. S. A. E., Pl. station 44 b, lat. 65° 56′ S., long. 54° 35′ W., depth 700—0 m.; 22. I. 1902; temperature at the surface — 1,15° C.: 1 juvenis; R. M. S., on a slide.

Distribution: — South part of the Atlantic Ocean and the Antarctic Ocean; between lat. 43° S. and 70° S.

All the stations of the „Antarctic“ expedition are consequently situated within the area of distribution stated by G. W. MÜLLER.

Conchoecia Belgicae G. W. MÜLLER.

Conchoecia Belgicae, G. W. MÜLLER, 1906 c, p. 4; figs. 1—11.
„ *innominata*, G. S. BRADY, 1907, p. 1; pl. II, figs. 7—14.
„ *Belgicae*, G. W. MÜLLER, 1908, p. 79.
„ „ „ „ „ 1912, p. 92.

Description: — See G. W. MÜLLER 1906 c, p. 4 and G. S. BRADY 1907, p. 1.

Supplementary description: — Male: —

Shell: — Length: According to G. W. MÜLLER 2,4—2,6 mm. The specimens investigated by me measured 2,5—2,6 mm. Length : height about 1,8 : 1; length : breadth about 2 : 1. Seen from the side it is of about the type reproduced and described by G. W. MÜLLER; see the appended fig. 1. Seen from below it is of about the same type as in *C. hettacra* ♂; see the appended fig. 2. The compound glands are as described by G. W. MÜLLER. In other respects it is like *C. hettacra*, but the selvage sometimes has within

the posterior margin of the shell more or less distinct leaf-like appendages of the kind reproduced in my fig. 4 of *C. symmetrica*.

F i r s t   a n t e n n a: — E-bristle: According to G. W. MÜLLER this bristle is furnished with „eine Doppelreihe von etwa 30 fast senkrecht abstehenden stabartigen, an der Spitze schwach kolbig (oder stempelartig?) erweiterten Gebilden". In the specimens investigated by me there were 27—30 of these processes in each row; they were of precisely the same type as the corresponding processes in *C. hettacra*. In other respects too this antenna agreed with the corresponding antenna in the species just mentioned.

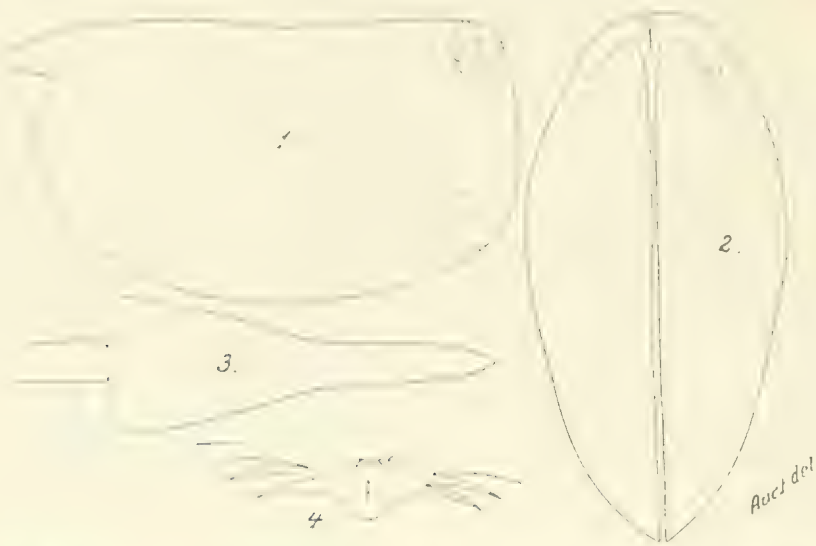

Fig. CXLVI. — *Conchoecia Belgicae* G. W. MÜLLER. ♂. 1. Shell seen from the side; 28 ×. 2. Shell seen from below; 28 ×. 3. Distal part of the rod-shaped organ seen from below; 133 ×. 4. The middle part of the postero-ventral edge of the upper lip; 833 ×. (From specimens from station 42 b.)

S e c o n d   a n t e n n a: — This is quite like the same limb in *C. hettacra*. It seems impossible to find any difference even in the shape of the clasping organs of the endopodite; their shape is subject to some, though only slight, variation in this species just as in *C. hettacra*.

The m a n d i b l e, m a x i l l a, f i f t h, s i x t h and s e v e n t h   l i m b s, f u r c a, u p p e r   l i p and p a r a g n a t e s are like those of *C. hettacra*.

The p e n i s is of about the type reproduced in pl. II, fig. 13, G. S. BRADY, 1907; its copulatory appendage is like that of *C. hettacra*.

The r o d - s h a p e d organ is the same as is described and reproduced by G. W. MÜLLER.

Syn. nom. *Remark:* — Although there are a number of small differences between *C. innominata* as described by G. S. BRADY and the species dealt with above, there seems to be no doubt that G. W. MÜLLER's identification of these two forms is quite correct.

Habitat: — A n t a r c t i c   O c e a n:

S. A. E., Pl. station 42 b, lat. 65° 49′ S., long. 58° 40′ W.; depth 250—0 m.; 18. I. 1902; temperature at 250 m. and at the surface — 1.35° C. and + 1.10° C. resp.: 3 mature males and 2 juvenes; R. M. S. 322.

Distribution: — Antarctic Ocean south of lat. 64° S.

My specimens were consequently caught within the area of distribution stated before.

Conchoecia Valdiviae G. W. Müller.

Conchoecia Valdiviae, G. W. Müller, 1906 a, p. 123; pl. V, fig. 1; pl. XXIII, figs. 8, 10—19.
„ „ „ „ „ 1908, p. 79.
„ „ „ „ „ 1912, p. 93.

Description: — See G. W. Müller, 1906 a, p. 123.

Supplementary description: — Female: —

Shell: — Length: According to G. W. Müller „ziemlich konstant 5,5 mm.". The specimen investigated by me was 5,4 mm. long. Length : height about 1,75 : 1; length : breadth about 2,3 : 1. Seen from the side it is of about the type described and reproduced by G. W. Müller; see the appended fig. 1. Seen from below (fig. 2) it is narrowly oval, with its greatest width at about the middle and the anterior and posterior parts of about equal size and of the same type; the side contours are evenly curved, the ends well rounded and the rostrum symmetrical. The shoulder vault is rather weakly developed and well rounded. The surface of the shell has a few scattered moderately long or short bristles. The sculpture and the compound glands are the same as are described by G. W. Müller. Seen from inside: The glands along the posterior margin of the shell are about the same as are described on p. 618 above for *C. oblonga*. The selvage is of the same type as is described for *C. borealis* p. 709 above. At the posterior dorsal corner of the shell there is a well developed oblong hinge-socket and hinge-tooth (of about the same type as is reproduced above for *C. hettacra*).

First antenna (fig. 3): — This has rather weak division into joints. The bristle of the second joint is somewhat shorter than the capitulum of the rod-shaped organ and has short hairs. The e-bristle is not sword-shaped distally; it is almost or quite bare proximally on the anterior side. All the joints are partly furnished with short, rather fine spines.

Second antenna: — Protopodite: In the specimen investigated by me this measured 2,2 mm. Exopodite: The proportion between the length of this branch and that of the protopodite is about 11—12 : 20. The proportion between the length of the first joint and the total length of the eight distal joints is about 10 : 4. The proportion between the length of the longest natatory bristles and that of the exopodite is about 3 : 2. The first joint has rather few spines proximo-dorsally. Endopodite: This has three joints. First joint: The a- and b-bristles are bare or have only a few short hairs. The processus mammillaris has a small papilla distally. Second joint: The c- and d-bristles are developed and are about the same size as is seen in pl. XXIII, fig. 8, G. W. Müller, 1906 a. The g-bristle is somewhat longer than the protopodite; the f-bristle is about a third shorter than the g-bristle; both are furnished with short hairs and are not sword-shaped distally. End joint: The h-, i- and j-bristles are subequal, somewhat less than half the length of the g-bristle, and are about as thick proximally as the f-bristle; all of them have rather slight indications of shafts and are moderately densely furnished with spines proximally. There is an extremely small papilla between the h- and i-bristles. The second joint of the endopodite is bare.

Mandible: — This limb agrees almost completely with the one described above for *C. symmetrica*, but all the four bristles on the posterior side of the first endopodite joint have short hairs.

Maxilla: — Most of the bristles on the endites of both the procoxale and the coxale are very powerfully armed. Endite on the procoxale: The three antero-inner bristles are furnished with long secondary bristles and all the postero-outer tube-bristles have rather long spines. On the maxilla of one side there were four postero-outer tube-bristles in the specimen investigated by me; the accessory (abnormal?) bristle was of about the same length as the three others

Fig. CXLVII. — *Conchoecia Valdiviae* G. W. Müller, ♀. — 1. Shell seen from the side; 16 ×. 2. Shell seen from below; [illegible]. 3. Distal part of the left first antenna (the distal bristles are broken) + the rod-shaped organ; 52 ×. (From a specimen from station 64 b.)

but considerably weaker than these. The spines situated distally-medially on the first endopodite joint are relatively large and powerful. The end joint is about the same as in *C. borealis*.

Fifth limb: — This is about the same as in *C. symmetrica*. The two shorter of the three antero-ventral bristles on the endopodite have short hairs.

Seventh limb: — The end joint has spines.

The furca, upper lip and paragnates are similar to those of *C. symmetrica*.

Rod-shaped organ: — The shaft extends somewhat distally of the point of the first antenna; see the appended fig. 3. The capitulum is of about the type described and reproduced by G. W. Müller.

Habitat: — Antarctic Ocean:

S. A. E., Pl. station 64 b, lat. 48° 27′ S., long. 42° 36′ W.; depth 2500—0 m.; 23. VI. 1902: 1 mature female and 1 juvenis; R. M. S. 323.

Distribution: — Atlantic and Antarctic Oceans between lat. 18° N. and lat. 58° S. Indian Ocean.

The „A n t a r c t i c" specimens were consequently caught within the area of distribution stated by G. W. MÜLLER.

Genus Euconchoecia G. W. MÜLLER.

Euconchoecia, G. W. MÜLLER, 1890 a etc.; this name is also used in the following works: G. S. BRADY, 1902 a, P. T. CLEVE, 1905, TH. SCOTT, 1909 and 1912 a, V. VÁVRA, 1906. *Halocypris* (part.), TH. SCOTT, 1894 and *Paraconchoecia* (on account of a mistake in the determination), P. T. CLEVE, 1900.

Description: — S h e l l: — The rostrum is well developed. The „unsymmetrical glands" have their exit symmetrically on the posterior margin of the shell near the posterior dorsal corner; they are sometimes rather small. Apart from these there are no large groups of glandular cells at all. The pores of the surface are small and difficult to verify with certainty. The part of the selvage that runs on the rostrum has no spines.

F i r s t a n t e n n a: — This shows marked dimorphism.

M a l e: — This is moderately long and powerful; it grows gently narrower distally. It has five joints, but the boundary between the third and fourth joints is often rather difficult to ascertain with certainty. The proportion between the lengths of the joints seems to be subject to rather slight variation in the species so far known; I may give as an example the result of measurements made by me on *E. Chierchiae*:

$$\text{I} : \text{II} : \text{III} : \text{IV} : \text{V} : \quad \text{about } \tfrac{10}{11} : \tfrac{12}{7} : \tfrac{1}{4} : \tfrac{7}{4} : \tfrac{1}{1}.$$

The second and third joints have no bristles at all. The fourth joint has numerous bristles ventrally (from close on twenty to a considerably larger number); these are developed as thin-walled sensorial filaments. All these bristles are of the same type, moderately long and all of about the same length, moderately thick or rather narrow, of about equal thickness throughout their whole length, rounded distally, almost straight and bare. The end joint has four or five bristles, all without spines. Two of these bristles are rather powerful and long, of different lengths, the longest being rather considerably longer than this antenna, the other about half or three-quarters of the length of the former one, both rather strongly and evenly bent ventrally. The two or three remaining bristles on this joint are moderately long or rather short and rather weak, straight or irregularly bent.

F e m a l e: — This is rather considerably shorter and weaker than that of the male, with a comparatively weakly developed muscular system (cf. p. 580 above) and with rather indistinct division into joints. The number of joints seems to vary; according to what has been stated it seems that in most cases only three joints can be distinguished, but sometimes, however,

the boundary between the original third and fourth joints can be traced (in the species described by me below, *E. Chierchiae*, the original fourth joint is moved by special muscles); in exceptional cases even the proximal boundary of the original fifth joint is, though only partly, perceptible. The proportions between the lengths of the (original) joints are about the same as in the male, but the original fifth joint is exceedingly small and weak. The bristles on the original fourth joint are of about the same type and number as in the male. The original fifth joint has a somewhat fewer number of bristles than in the male (from two to four were observed); these bristles are about as thick as or somewhat thinner than the sensory bristles on the original fourth joint; some of them are, however, perhaps somewhat stronger than these; the longest of them is about as long as or rather slightly longer or shorter than the bristles on the original fourth joint.

Second antenna:

Male: — The protopodite has no verrucae (contrary to the genus *Conchoecia*). The first joint of the exopodite is almost equally thick throughout its length. Endopodite: The first joint is extensive, more or less conical and has no processus mammillaris. The second joint has only two bristles, the f- and g-bristles, one of which is very long, sometimes even as long as or somewhat longer than the shell. On the right endopodite the end joint is developed as an elongated powerful clasping organ, with long proximal and distal shanks. Its three bristles are attached at the angle between the proximal and distal shanks and are strikingly different in length. On the left endopodite this joint has no distal shank; its proximal shank is of the same type as that on the right side. The three bristles are situated distally on the joint.

Female: — The protopodite is similar to that of the male. Endopodite: This has two joints. The first joint is like that of the male, but is somewhat weaker. The second joint has, as in the male, only the f- and g-bristles, the longer of which is somewhat shorter than in the male. The original third joint is almost completely reduced and has a varying number (one to three) of bristles; it is joined to the original second joint.

The mandible, maxilla, fifth, sixth and seventh limbs, penis, furca and lips are so incompletely known in the species described by preceding writers that it did not seem to be convenient to include them in the genus diagnosis. With regard to these organs I shall only refer to the description of *E. Chierchiae* given below.

Rod-shaped organ: — This shows no — or at any rate very slight — dimorphism. It is narrow, uniformly thick, and unjointed, in most cases slightly arched ventrally or almost straight. For this organ in *E. lacunosa* G. W. MÜLLER, see p. 575 above of the sub-family diagnosis.

Number of species.

Remarks: This genus comprises only four species described so far, namely:

E. Chierchiae, G. W. MÜLLER, 1890 a, p. 277; pl. XXVIII, figs. 1—10.

E. aculeata (TH. SCOTT, 1894), G. W. MÜLLER, 1906 a, p. 129; pl. XXXII, figs. 18—23, 25, 26.

E. lacunosa, G. W. MÜLLER, 1908, p. 80; pl. X, figs. 1—8.

E. d'Arcy-Thompsoni, TH. SCOTT, 1909, p. 128; pl. III, fig. 19; pl. IV, figs. 1—12.

As is shown, however, by the remark under *E. Chierchiae*, p. 753 below, it is not quite impossible that the first of these four species, in the scope that it is taken by G. W. MÜLLER, 1906 a, comprises two very closely-related forms.

Relations between the species.

The first two of these species, *E. Chierchiae* and *E. aculeata*, are certainly rather closely connected to each other; on the other hand they show rather far-reaching differences from *E. lacunosa* and *E. d'Arcy-Thompsoni*. It is rather difficult to say anything certain about the relation between the two last-mentioned species, partly because the male of *E. lacunosa* is quite unknown, and partly because of the incompleteness of the descriptions. But it seems to me not improbable that they are fairly closely related. These reasons also make it impossible to decide whether these two species are to be distinguished as the representatives of a special sub-genus; it seems, however, fairly probable that future investigations will make this necessary.

First antenna.

First antenna: G. W. MÜLLER, in his work 1906 a, states that this antenna is five-jointed in the male, „die Grenze zwischen dem 3. and 4. Glied ist schwer zu erkennen". In his work of 1912 this writer states that this antenna is four-jointed: „1. Antenne des ♂ mit 3 längeren Gliedern und einem 4. sehr kurzen Gliede". In the latter work it is obvious that the third and fourth joints are taken as one joint. As will be seen above, I have adopted the former view in the genus description, because in the species investigated by me the two last-mentioned joints were distinctly separated; the fourth joint (sensu meo) was even moved by several special muscles.

This same author writes in his work, 1890 a: „die Borste des zweiten Gliedes fehlt überhaupt; an der Stelle, wo sie beim Weibchen von *Conchoecia* steht, findet sich eine flache Grube, welche auf ihre frühere Existenz an dieser Stelle hinzuweisen scheint." It was unable to observe any such cavity; it seems to me not at all impossible that this is a mistake on the part of this writer.

In the diagnosis of this genus, 1906 a, p. 127, G. W. MÜLLER states that from the third joint of the first antenna of the males „ragt ein hakenartiger Fortsatz in das 4. hinein; derselbe liegt medial; ist nicht immer gleich deutlich. Ich habe keine volle Klarheit über seine Lage und Bedeutung gewinnen können. Anscheinend liegt er im Innern des Gliedes, dient dem Muskelansatz." — I was not able to observe any such chitinous process on the specimens of this genus that were investigated by me. It does not seem impossible, however, that this is a mistake on the part of G. W. MÜLLER. The ventero-medial part of the wall of the fourth joint in the male first antenna of *E. Chierchiae* is rather strongly chitinized. The dorsal boundary of this part is indicated in the adjoining fig. 12 by a line running longitudinally at about half the height of the joint. Does this part correspond to the process mentioned by G. W. MÜLLER? This does not seem impossible to me; its medial position is in favour of this; as is shown by the above quotation, G. W. MÜLLER himself was not quite certain whether the process in question was really situated inside the joint; its medial position, on the other hand, was quite clear. (This process is not mentioned in this author's work of 1912.)

Mandible.

Mandible: To judge from pl. X, fig. 7, G. W. MÜLLER, 1908, *E. lacunosa* shows, with regard to the structure of the pars incisiva of the coxale, a type quite different not only from *E. Chierchiae*, described below, but from all the forms hitherto known in the family *Halocypridae*. G. W. MÜLLER's reproduction and description of this organ are, however, so incomplete and indistinct that I did not think it right to pay any attention to this information in working out the genus and sub-family diagnoses.

I am somewhat doubtful about the homologization of the masticatory pad and the oval cavity on the pars incisiva on the coxale in this genus. Does the masticatory pad in this genus correspond to the masticatory pad + the part surrounded by the bristles and hairs or only to the former in the genus *Conchoecia*? And in the latter case does the part surrounded by the bristles and hairs in the latter genus correspond to the oval cavity in *Euconchoecia*? It does not seem possible at present to answer these questions with full certainty.

Euconchoecia Chierchiae G. W. MÜLLER.

? *Euconchoecia Chierchiae*, G. W. MÜLLER, 1890 a, p. 277; pl. XXVIII, figs. 1—10.
Paraconchoecia oblonga, P. T. CLEVE, 1900, p. 40.
Euconchoecia Chierchiae, G. S. BRADY, 1902 a, p. 190; pl. XXIV, figs. 9—15.
? „ „ (part.), G. W. MÜLLER, 1912, p. 96.

Description: — Male: —

Shell: — Length, 1.15—1.25 mm. Length : height about 2 : 1; length : breadth about 2.3 : 1. Seen from the side (fig. 1), it is moderately elongated, with its greatest height somewhat in front of the middle and the anterior part of the shell somewhat, though rather slightly, larger than the posterior part. The ventral margin is moderately strongly and uniformly curved and passes without corners into the anterior and posterior margins. The posterior margin is also uniformly and moderately curved; it forms an angle of about 90° with the dorsal margin. At the posterior dorsal corner the right valve is in most cases* armed with a moderately long, narrow spine, more or less pointed distally. The left valve is more or less rounded here, armed in most cases with a very small spine (fig. 4); the latter is sometimes quite absent, however (as in fig. 8 of the female); in exceptional cases (cf. p. 754 below) both valves have a well developed spine in this corner. The rostrum points almost straight forward; it is rather broad and symmetrical (fig. 5). The shoulder vault is rather small, well rounded, not wing-shaped. Seen from below (fig. 2), the shell is somewhat lentil-shaped, with its greatest breadth somewhat in front of the middle and its anterior part distinctly larger than the posterior part; it is rather broadly rounded anteriorly and grows narrow rather rapidly posteriorly, where it becomes pointed; the side-contours are rather evenly curved. In the specimens investigated by me the surface of the shell had no perceptible sculpture and no hairs. There are no signs of a hinge-socket or a hinge-tooth postero-dorsally. Seen from inside: The selvage* is very narrow and extremely difficult to verify with certainty; as far as I could observe it had a whole margin throughout its length, even on the rostrum. The lamellae of the shell are exceedingly thin; the part at which they are joined is narrow.

First antenna (fig. 12): — The first joint has disto-ventrally a rather large, verruciform, rounded process. (A process of about the same kind is found in all the males of this genus in which this antenna is known; is it a generic character?) The fourth joint has ventrally somewhat more than twenty (21—24 found) sensory bristles, arranged in three longitudinal

* Cf. the remark on this species, p. 752 below.

rows situated close together, from seven to nine in each row; in the specimens investigated by me the number in the inner row was always seven. The length of these bristles is somewhat less than or equal to the total length of the first and second joints. The longest of the bristles on the end joint is about twice as long as this limb, the next longest is about a third or somewhat more shorter than the former one. The middle of the three shorter ones is about as long as the total length of the two proximal joints of this antenna; The ventral one is about half this length, the dorsal one still somewhat shorter. The dorsal one of the three shorter of these bristles has in most cases short, fine hairs, the others are bare or almost bare. For the chitinization of the fourth joint see p. 739 above. All the joints are quite bare.

Second antenna: — The protopodite is about ½ mm. long. Exopodite: The proportion between the length of the protopodite and that of the exopodite is about 5 to 3. The proportion between the length of the first joint and the total length of the eight distal joints is about 2 to 1. The eighth joint is well developed, about as long as the next preceding joint. The first joint is bare; its ventero-distal bristle is of the ordinary type, more or less straight, about as long as the total length of the two or three following joints, very weak and bare. The natatory bristles on the second to the eighth joints are all of about the same length — the distal ones are only slightly shorter than the proximal ones — about a quarter to a third longer than this branch. They agree with each other in their type as well; the distal part, about a fifth to a seventh of the length of the bristle, is bare and hyaline, but only very slightly or not at all lancet-shaped (sensory organ); proximally of this part the bristles are furnished with comparatively long natatory hairs almost right down to the base. The end joint has only two bristles. The ventral one of these is about as long as this branch and is of the same type as the natatory bristles on the preceding joints; the dorsal one is short, about as long as the total length of the three to five distal joints, and bare. Endopodite (figs. 21 and 22): The a- and b-bristles on the first joint are bare, comparatively short and weak; the longer one is about as long as or somewhat longer than half the length of the second joint, the other is about half as long as the longer one or somewhat more. Second joint: This is about half as long as the first joint, rather powerful and somewhat rounded on the right endopodite, somewhat more oblong on the left. This joint has a rounded or somewhat broadly conical smooth verruca antero-distally; this verruca is rather powerful on the right, rather small and weak on the left endopodite. Of the f- and g-bristles one is about as long as or somewhat longer than the shell, the other is about a third of this length or somewhat more; they are both rather powerful proximally and hyaline distally, narrow and bare or sparsely furnished with short hairs. The end joint on the right endopodite is rather narrow, and is about equally thick throughout its length; it forms an acute angle, its proximal shank being more or less straight, its distal shank, which is somewhat longer than the proximal one, is evenly curved; it is distally rounded and has a few rather powerful transverse ridges. Of its three bristles one is short, about as long as the width of the joint, and bent into a hook; the two others are moderately long, one about as long as the proximal shank of the joint, the other about twice as long or somewhat more. All these three bristles are bare and narrow, somewhat flattened distally. On the left endopodite this joint is about as long as the proximal shank of the end joint on the right endopodite; its bristles too have the

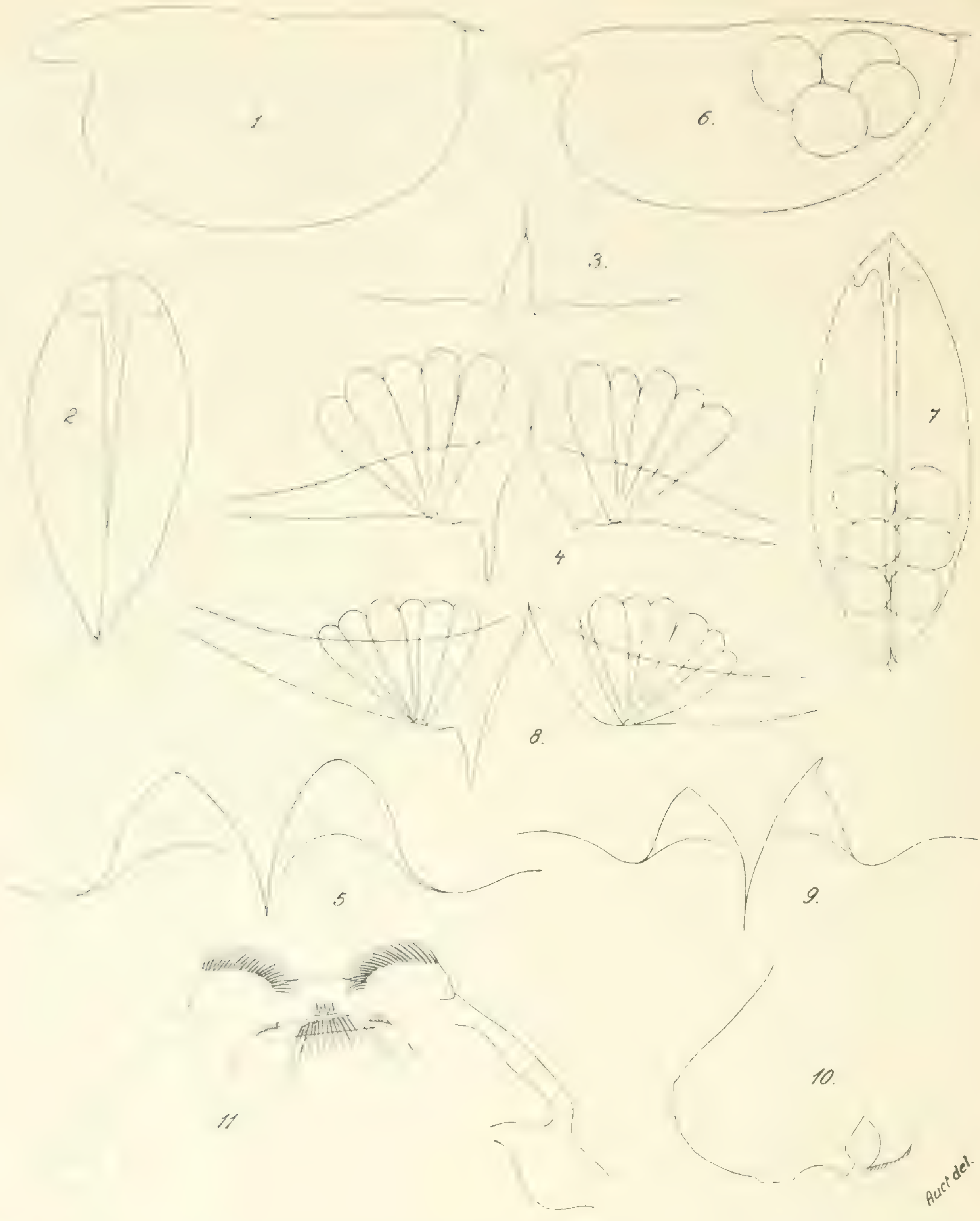

Fig. CXLVIII. — *Euconchoecia Chierchiae* G. W. Müller. — 1. Shell seen from the side, ♂; 64 ×. 2. Shell seen from below. ♂; 54 ×. 3. Posterior part of the shell seen from outside, ♂; 134 ×. 4. Posterior part of the shell seen from inside. ♂; 260 ×. 5. Anterior part of the shell seen from inside, ♂; 134 ×. 6. Shell seen from the side, ♀; 64 ×. 7. Shell seen from below, ♀; 64 ×. 8. Posterior part of the shell seen from inside, ♀; 260 ×. 9. Anterior part of the shell seen from inside. ♀; 134 ×. 10. Upper lip and the left paragnate seen from the side, ♀; 186 ×. 11. Postero-ventral part of the upper lip seen from above, ♂; 834 ×. (Fig. 3 from a specimen from lat. 42° 9′ N., long. 42° 15′ W., the other figures from specimens from Cruz Bay, St. Johns.)

same proportions. Pilosity: On the anterior side of the first joint of the endopodite there are exceedingly short hairs more or less abundantly. Otherwise this branch is bare.

M a n d i b l e (fig. 20): — P r o t o p o d i t e: Coxale: The toothed edge of the pars incisiva has twelve or thirteen moderately large, simple, smooth, triangular teeth, of which the two anterior ones are rather considerably larger than the others (fig. 15). The distal tooth-list, which is only slightly narrower than the toothed edge of the pars incisiva, is furnished with twelve to fourteen teeth. Of these the two posterior ones are very large, tusk-like and smooth; of the others, all of which are simple, smooth, triangular and moderately large, the most anterior one is often the largest (fig. 16). The proximal tooth-list is very narrow, being only about a third of the width of the distal tooth-list, and is attached at or somewhat behind the middle of this; it consists of from five to eight moderately large or small, smooth teeth, usually decreasing in size the more anteriorly they are situated; they vary somewhat in type; cf. figs. 14, 16, 17. (It does not seem impossible that the larger of the two posterior teeth on the distal tooth-list actually belongs to the proximal tooth-list; cf. figs. 14 and 16.) The masticatory pad is very large, about as wide as or rather slightly narrower than the distal tooth-list, simple, and (when it is pressed beneath the coverglass) cut off distally about parallel to the toothed edge of the pars incisiva and armed with very close, short, fine spines. Somewhat proximally of the masticatory pad there is a large oval cavity with a sharp, raised edge. This cavity is situated longitudinally on and somewhat in front of the middle of the pars incisiva; it is about as long as the width of the masticatory pad, is smooth inside and is furnished posteriorly on the outside with close, short, fine spines; near the edge of the cavity there are also rather numerous moderately long, fine spines. In addition this cavity has on the inside of the posterior edge a dense row of eight to ten smooth, usually simple, lancet-bristles of moderate size (see p. 583 above, under the special terminology for the genus *Halocypris*); these lancet-bristles can be opened out like a fan (see fig. 18 and G. W. MÜLLER, 1890 a, pl. XXVIII, fig. 10); when pressed together they go down into the cavity (see fig. 14). Basale: The six teeth on the distal edge of the endite are all of about the same width; most of them are furnished with comparatively strong secondary teeth; the anterior one or the two anterior ones of these teeth are rather low, with little or even no difference between the main point and the secondary teeth. The anterior one of the two processes situated posteriorly on this edge is a very short and bare tube-bristle; the posterior one is dagger-shaped and furnished in most cases with more or less powerful secondary teeth. The single tooth on the outside of this endite is situated proximally of distal teeth nos. 2 and 3 (counting from in front), is of about the same size and strength as the distal teeth and is in most cases serrated on the anterior edge. The bristle on the anterior edge of this endite is about as long as the distal edge of the endite. The three other bristles on this process are about two or three times as long as the bristle just mentioned and are situated somewhat proximally of and behind it. All these four bristles have short, fine hairs, almost bare. Apart from these this joint has no bristles. The e p i p o d i a l a p p e n d a g e is represented by a very long bristle*, which is about as long as the anterior side of the two proximal endopodite joints and has sparse, long

* Or else it is quite absent. In this case the bristle mentioned above as the remains of the epipodial appendage corresponds to the bristle that is situated distally on the inside of the basale in *Halocypris* and *Conchoecia*.

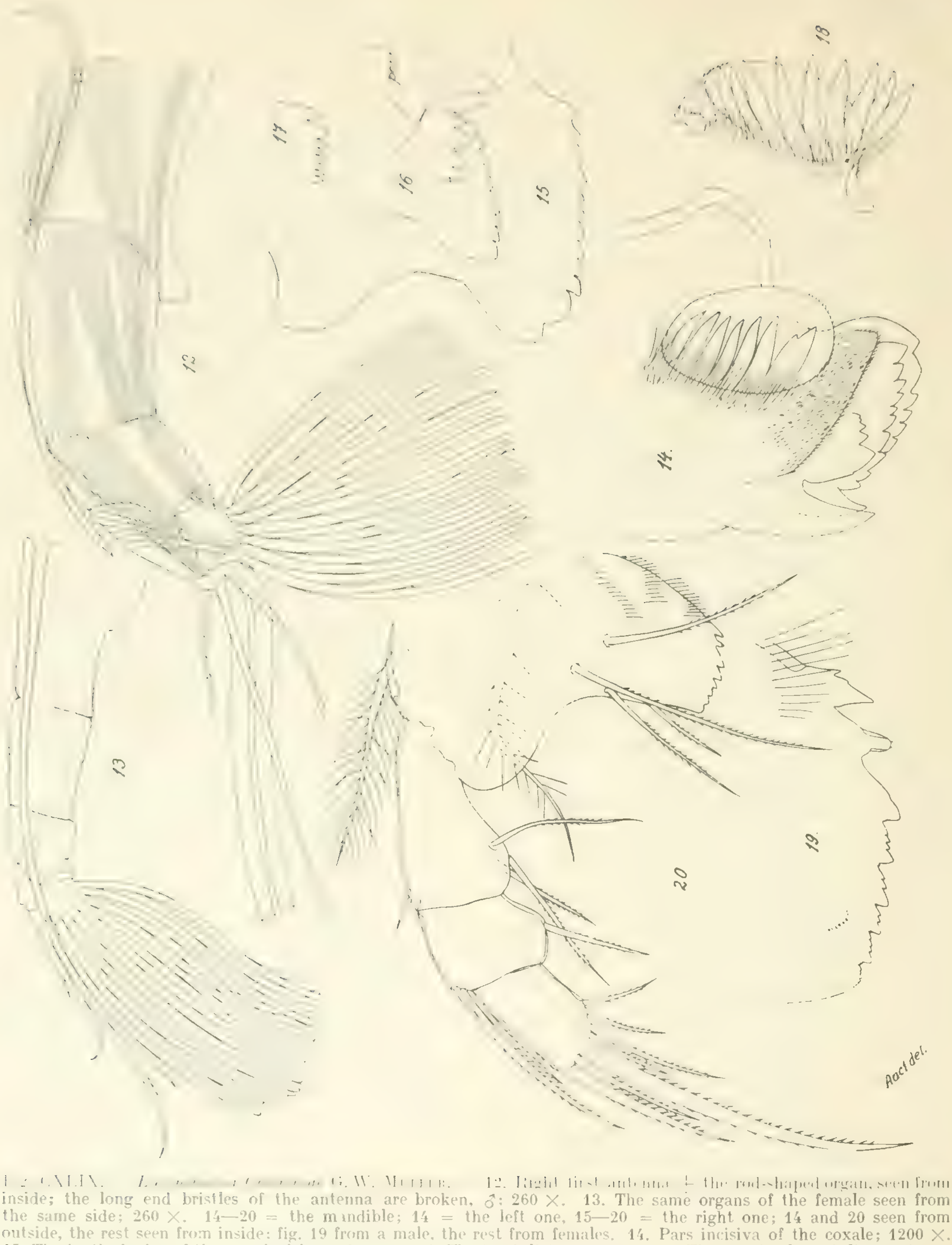

Fig. CXLIX. [illegible] G. W. Müller. 12. Right first antenna + the rod-shaped organ, seen from inside; the long end bristles of the antenna are broken, ♂: 260 ×. 13. The same organs of the female seen from the same side; 260 ×. 14—20 = the mandible; 14 = the left one, 15—20 = the right one; 14 and 20 seen from outside, the rest seen from inside: fig. 19 from a male, the rest from females. 14. Pars incisiva of the coxale; 1200 ×. 15. The toothed edge of the pars incisiva; 1200 ×. 16. The tooth-lists; 1200 ×. 17. The proximal tooth-list; 1200 ×. 18. The oval cavity; 1200 ×. 19. Distal part of the endite of the basale; 1200 ×. 20. The basale + the endopodite; 340 ×. (From specimens from Cruz Bay, St. Johns.)

hairs. The exopodite is also represented only by a bristle, which is in most cases not quite so long as the epipodial bristle. Endopodite: First joint: This has antero-distally a very short and almost bare bristle, which is often even shorter than in the adjoining figure. It has posteriorly three bristles, which have short, fine hairs, almost bare, and are somewhat different in length, being about as long as or somewhat shorter than this joint. Second joint: Of the three bristles situated antero-distally one is about one and a half times or twice as long as the anterior side of the third joint, one is about as long as the anterior side of the third joint and the third is very short. The longest of these three bristles is furnished with short, rather weak spines, the two others have short, fine hairs, almost bare. On the posterior side of this joint there is only one bristle, which has short, fine hairs and is about the same length as the end joint. End joint: Of the seven distal bristles on this joint the third (counting from the front) is very powerful, somewhat longer than the anterior side of the first and second endopodite joints and furnished with moderately powerful secondary spines. The most anterior one is of the same type as the former one, but is only about half as long. The other five bristles are moderately strong or rather weak, with short, fine hairs or almost bare; the second (counting from the front) and one of the four posterior ones are slightly shorter than the most anterior one; the three others are only about half as long as the latter bristle. Pilosity: Except for the groups of hairs posteriorly on the endite the basale seems to be quite bare; the first and second endopodite joints are bare.

Maxilla: — Protopodite: The endite on the procoxale has seven bristles. Of these the antero-inner one and the two postero-outer ones are of the tube-bristle type. The former is moderately long, rather powerful and has two transverse wreaths of long, stiff secondary bristles. The two others, one of which is attached somewhat proximally of the other bristles, are rather considerably shorter and weaker and have short, fine hairs or are almost bare. The four remaining bristles on this endite are rather powerful, pointed, finely pectinated or almost bare, and are of moderate and somewhat different lengths (the proportions are often the same as in the adjoining figure 24). The endite on the coxale (fig. 25) is armed with thirteen bristles, seven of which are situated on the posterior and six on the anterior process. Of the seven former ones the postero-inner one is moderately long and strong, pointed, moderately strongly pectinated and is situated somewhat proximally of the others. The one situated next to this is somewhat shorter, but very powerful and pointed; it is weakly pectinated or almost bare. Two bristles are of the tube-bristle type, rather short and moderately strong, bare or almost bare. The three remaining ones are all of the same type, pointed and moderately strongly or rather weakly pectinated; the most anterior one is moderately long, but rather powerful, the two others decrease in most cases rather much in length and strength the more posteriorly they are situated. Of the six bristles on the anterior process on this endite the antero-outer one is of about the same type as the postero-inner bristle of the posterior process, but is somewhat shorter and weaker; three are of about the same type and size as the next posterior bristle on the posterior process, the two remaining ones are tube-bristles and of about the same type and size as the tube-bristles on the posterior process of this endite. The basale (fig. 26) has a single short-haired or almost bare tube-bristle, the point of which almost reaches the distal

Fig. CL. *Euconchoecia Chierchiae* G. W. Mueller. — 21 and 22. Endopodite of the right and left second antenna (the three longest bristles are broken) seen from inside, ♂; 382 ×. 23. Endopodite of the left second antenna (the two longest bristles are broken) seen from inside, ♀; 382 ×. 24. Endite of the procoxale of the right maxilla seen from inside and behind, ♀; 1350 ×. 25. Endite of the coxale of the right maxilla seen from outside and behind, ♀; 1350 ×. 26. Basale + endopodite of the right maxilla, seen from inside, ♀; 712 ×. (From specimens from Cruz Bay, St. Johns.)

boundary of the first endopodite joint. Endopodite (fig. 26): The first joint has along its anterior edge a sparse row of five long bristles, differing somewhat in length, the longest being somewhat longer than this joint, the shortest about as long as the width of this joint; they all have short, fine hairs, almost bare; the distal one is in most cases of the tube-bristle type, the others are pointed. On the posterior edge of this joint there are three bristles, situated at some distance from each other somewhat distally of the middle of this joint; they are of somewhat different lengths, the longest being about as long as the width of this joint, the shortest somewhat more than half of this length; they all have short, fine hairs, almost bare; they are either all well pointed or one or two of them are of the tube-bristle type. The inner bristle on this joint is very much displaced posteriorly, and is situated close to the three posterior bristles; it is about as long as the shortest of the three just mentioned and has short, fine hairs; it is usually of the tube-bristle type. The end joint is comparatively short and thick, only about as long as half the middle breadth of the first endopodite joint. It is provided with six distal bristles; this is noteworthy, as the other species of this sub-family that are dealt with in this work have only five bristles on this joint. Of these bristles the anterior and the posterior ones are rather strong, the others are moderately strong or rather weak; the anterior one is about as long as the anterior side of this joint, the posterior one is in most cases not quite twice this length. The rest vary somewhat in length, the longest of them being in most cases about as long as the most posterior one, the shortest about as long as or somewhat shorter than the anterior one; they are all finely pectinated or almost bare; some of them are of the tube-bristle type (there is variation in this last character). Pilosity: A couple of transverse rows of rather long, stiff hairs are found on the two endites. A collection of similar hairs is also seen on the inside of the first endopodite joint, anteriorly at about half-way along the joint. In addition the end joint has a transverse row of similar hairs on the anterior side about half-way along the joint. It is to be noted that the first endopodite joint has no spines at all distally on the inside.

Fifth limb (fig. 27): — The protopodite is unjointed. On its first endite there are two bristles, the proximal one of which is a short and short-haired tube-bristle, the other being about as long as the breadth of this joint (calculating from front to back); it is armed at the middle with numerous rather long, stiff secondary bristles, has short hairs distally and is pointed. On the second endite there are three bristles, two of which are of the same type and about the same length as the short tube-bristle on the first endite, the remaining one being of the same type and about the same length as the long bristle on the first endite. The epipodial plate has only four bristles in the middle group. Endopodite: This has constantly eight bristles. Two of these, one situated proximally on the anterior side of the process close to the protopodite and one situated ventrally near the exopodite, are of the same type and about the same length as the long bristles on the endites of the protopodite. The others have short, fine hairs, almost bare, and are of different lengths; one of these, situated disto-ventrally on the process, is somewhat shorter than the two former, and rather powerful, the one situated close to this is of the same type but only about half as long, one is about as long as the longer of the two powerful ones, but is weak, the others are more or less short and often of the tube-bristle type. Exopodite: First joint: This has usually five, in exceptional cases four, short-

Fig. CLI. — *Euconchoecia Chierchiae* G. W. Müller. — 27. Left fifth limb (except the epipodial appendage) seen from inside, ♂; 337 ×. 28. Right sixth limb (except the epipodial appendage) seen from outside, ♂; 292 ×. 29. Right sixth limb (except the epipodial appendage) seen from inside, ♀; 450 ×. 30. Furca, ♂; 225 ×. 31. Penis, seen from inside; 210 ×. 32. Distal part of the penis, seen from outside; 555 ×. (From specimens from Cruz Bay, St. Johns.)

haired bristles ventrally. Most of these are usually of the tube-bristle type and are about as long as the proximal height of this joint; three (two) of these are situated about half-way along the joint, the two others are placed distally. Laterally at about the middle of this joint there are two bristles, of about the same length as the former ones, but with long, soft hairs, and short hairs distally; they are pointed. The bristle situated dorso-distally on this joint is very long, being about as long as the total length of the first and second exopodite joints; it has short, fine hairs and is pointed. The three bristles on the second joint have short, fine hairs. The two ventral ones are subequal, somewhat more than half the length of this joint. The dorsal one is about as long as this joint. The dorsal one is usually pointed, the ventral ones usually of the tube-bristle type. End joint: The middle one of the three bristles is rather powerful and about as long as the total length of the two distal exopodite joints; it is finely pectinated; its point is in most cases of about the type reproduced in fig. 28 of *Conchoecia symmetrica.* The two others are somewhat shorter and weaker and have short, fine hairs; they are of the tube-bristle type or are pointed. Pilosity: Proximo-anteriorly on the protopodite there are groups of short, fine hairs; the first exopodite joint has groups of soft hairs, principally proximo-ventrally and dorsally, but sometimes medio-distally as well.

Sixth limb (fig. 28): — This is large and powerful and has a very powerfully developed musculature; it is used as an auxiliary organ in swimming: The protopodite is unjointed. Endopodite: This is quite joined to the protopodite; its special musculature has quite disappeared. It has two short-haired, pointed bristles, one of which is about as long as the width of the protopodite (calculating from front to back), the other is often only about half as long; both are attached antero-ventrally on this part. Exopodite: First joint: Scattered along the ventral side, somewhat medially, there are five bristles of the same type as the two just mentioned, about as long as or rather slightly shorter or longer than the proximal height of this joint. Laterally at about the middle of this joint there is a single bristle of the same type and about the same length as the ventral bristles. The dorso-distal bristle on this joint is bare or almost bare, pointed, and about as long as or somewhat shorter than half the length of the second exopodite joint. Second joint: Ventrally at or somewhat in front of the middle there are (contrary to all the other species of this sub-family known to me) two subequal, bare or almost bare, pointed bristles, one situated somewhat distally of the other, in most cases not quite half the length of this joint. Third joint: The two bristles are bare or almost bare, pointed and subequal, almost as long as this joint; they are situated somewhat in front of the middle of the joint. The three bristles of the fourth joint are subequal and all of the same type; they are about as long as or even somewhat longer than the exopodite; along the distal two-thirds of their length they are furnished with rather long natatory hairs, and are evenly and rather strongly curved ventrally (when in a state of rest these three bristles point dorso-posteriorly; their points are often visible at the postero-dorsal corner of the shell; it ought perhaps to be pointed out that these three bristles do not change into sensory organs distally). Pilosity: Anteriorly on the protopodite and the endopodite there are a rather sparse number of rather short, soft hairs. On the first exopodite joint there is a group of similar hairs proximo-laterally, somewhat ventrally.

S e v e n t h l i m b: — The longest end bristle is about a quarter of the length of the shell. The end joint is furnished with short, fine hairs.

P e n i s: — This has a marked ∼-shape. The part proximally of the contraction is almost as large as the distal part. It is rounded distally. There is no copulatory appendage. For further details see figures 31 and 32.

F u r c a (fig. 30): — This has seven claws; the armature of the claws is very weak. Between the first and second claw a rounded, verruciform process seems always to be developed. Behind the claws there is always an unpaired bristle, about as long as or somewhat shorter than the posterior claw. The lamellae are furnished with groups of rather short, stiff hairs, in most cases on both the medial and the lateral sides.

The r o d - s h a p e d organ is pointed distally (sometimes it has two points) and reaches about as far as the dorso-distal boundary of the third joint of the first antenna (fig. 12).

U p p e r l i p: — This projects rather decidedly and is rounded anteriorly. It is provided anteriorly with two low, rounded protuberances, one on each side, at some distance from the middle line (one of these protuberances is indicated in the adjoining figure 10), but apart from these it is smooth. The glands of the upper lip open out on two moderately large and somewhat rounded fields, one on each side, at some distance from the middle line and from the posterior ventral edge of this lip (one of these fields is shown by a weakly undulating line on the adjoining fig. 10). The posterior ventral edge of the upper lip is rounded (see fig. 11); its combs project rather decidedly and are furnished with numerous rather fine hairs. No glands have their exits on these combs. The part between these combs is about as broad as each of the latter and is weakly and uniformly convex.

The p a r a g n a t e s are of about the type reproduced by me for *Conchoecia rotundata*, p. 650 above. The chitinous lists behind the lower lip are of quite the same type as is reproduced for *Conchoecia symmetrica*.

F e m a l e: —

S h e l l: — This differs rather considerably from that of the male. Length, 1,10 to 1,3 mm. Length : height about 2,3 : 1; length : breadth about 2,75 : 1. S e e n f r o m t h e s i d e (fig. 6), it is elongated, with its greatest height at about the middle and the anterior and posterior parts of about the same size or the posterior part slightly larger than the anterior part. The ventral margin is like that of the male; the posterior margin, which is somewhat more weakly curved than in the male, forms, together with the dorsal margin, an angle that is rather considerably less than 90°. The posterior dorsal corner is of the same type as in the male, i. e. the right valve is always furnished with a spine, the left valve has in most cases an extremely small spine, which is sometimes quite absent (cf. fig. 8). The rostrum is bent somewhat more ventrally than in the male, and is rather narrow and unsymmetrical; the left rostral process is longer than the other and is drawn out distally in a more or less long point; asymmetry varies somewhat; it is seldom more distinct than in the adjoining figure 9, sometimes it is rather weak. The shoulder vault is not distinct. S e e n f r o m b e l o w (fig. 7) the shell is lentil-shaped, with its greatest breadth at or just behind the middle, the posterior part slightly or not at all larger than the anterior part, with pointed anterior and posterior

ends and weakly irregularly curved sides. The surface of the shell, hinge of the shell, selvage and lamellae of the shell are similar to those of the male.

First antenna (fig. 13): — The boundaries between the original first and second, second and third, and third and fourth joints are developed rather distinctly, and, at least sometimes, traces of the boundary between the original fourth and fifth joints can be found. The bristles on the original fourth joint are almost as long as the total length of the three proximal joints (only slightly shorter than in the male); the number found was 21—23. The original fifth joint has four bristles of different lengths; the longest one is in most cases somewhat shorter than the sensory bristles of the fourth joint, the shortest is about a third of the length of the longest one; there are sometimes a few short hairs distally on the longest one, the others are most frequently bare; the longest one is perhaps somewhat more powerful than the bristles of the original fourth joint, the others are weak. All the joints are quite bare.

Second antenna (fig. 23): — The proportion between the protopodite and the exopodite is about the same as in the male, but they are somewhat smaller, the protopodite being only about 0,4 mm. long. Endopodite: This is also somewhat smaller than in the male. The bristles of the first joint are of the same type and relative length as in the male. Second joint: This is somewhat less than half the length of the first joint. The distal verruca that is characteristic for the male is absent. The longest of the f- and g-bristles is about half as long as the shell or somewhat more (it measured 0,55—0,7 mm.), the other is about a third or somewhat more of this length; both are narrow and have short, fine hairs, almost bare. To the original third joint corresponds an exceedingly small verruca, situated at the place corresponding to that of this joint in the male; it is not bounded off from the original joint. It has only one bristle, which is of about the same type and relative length as the longest bristle on the end joint of this branch in the male. The endopodite is bare.

Mandible: — This is quite similar in males and females or at any rate dimorphism is scarcely perceptible. The only difference I could observe in the specimens investigated by me was that the four bristles on the endite of the second protopodite joint were perhaps somewhat longer in the males than in the females.

Sixth limb (fig. 29): — This is rather considerably smaller and weaker than that of the male; the musculature especially is considerably more weakly developed. In order to show the state of affairs with regard to size it may be pointed out that the male exopodite of this limb is about twice as long as the female one (excluding, of course, the end bristles). The endopodite is rather well marked off from the protopodite. (I cannot say anything about the musculature because of the bad state of preservation of the material.) The bristles are similar to those of the male. Exopodite: This has the same number of bristles as in the male. First joint: The five ventral bristles are in most cases subequal and relatively about as long as or somewhat longer than the corresponding bristles in the male; their length varies, however, to some extent. Three of them are in most cases of the same type as those of the male, two (in most cases nos. 3 and 5, counting proximally distally) have long hairs at the middle. The bristle at the middle of the outside of this joint is of about the same type and length as the two bristles just mentioned. The dorso-distal bristle, which has short, fine hairs,

is about as long as the second exopodite joint. Second joint: The two ventral bristles have short, fine hairs and are in most cases somewhat longer relatively than those of the male. Third joint: The bristles are like those of the male, with short, fine hairs. End joint: The dorsal one of the three bristles is in most cases about as long as the total length of the three distal joints; the middle bristle is somewhat shorter, the ventral one is the shortest, being about a third shorter than the dorsal one; these three bristles are of the same types as the corresponding bristles on the fifth limb. Pilosity: Hairs are developed at the same places as in the male sixth limb, but are in most cases somewhat more abundant.

The rod-shaped organ (fig. 13) is of the same type as in the male and reaches to about the point of the first antenna.

Eggs: — A particularly interesting point about this species is that the female carries her eggs for a time between the back of the body and the shell; as has already been pointed out (p. 561 above), this is the only case of care of the brood that has been found so far. (Curiously enough, it is not mentioned by preceding authors, although they investigated females; this fact has helped to prevent *E. Chierchiae*, G. W. MÜLLER, 1906 a and 1908, from being included in the list of synonyms given above; there were no females in the material of this species investigated by G. W. MÜLLER, 1890 a.) Some of the females investigated by me had no eggs in their brood-chambers; in others two to seven or even eight eggs were found; the eggs in the brood-chamber were comparatively large; cf. the adjoining figures 6 and 7.

Synonyms. *Remarks:* — The form described by me above is either very closely related to the *E. Chierchiae* from the coast of Brazil described by G. W. MÜLLER, 1890 a, or else it is identical with this form. In spite of a number of differences between the original description of this species of G. W. MÜLLER's and the specimens on which the description worked out by me above is founded I decided in favour of the latter alternative. This was due, first, to the fact that a number of the specimens investigated by me were caught not far from the type-locality of the species just mentioned, and, secondly, to the superficial nature of G. W. MÜLLER's original description, which makes it not improbable that these differences are due to mistakes on the part of this writer.

The following are the main differences between the original description of *E. Chierchiae* worked out by G. W. MÜLLER and the specimens investigated by me:

Shell: The right valve always had a moderately long spine postero-dorsally in the specimens investigated by me. In G. W. MÜLLER's original description it is stated that a spine of this sort was only found sometimes (five mature males were investigated by this author): „Bisweilen ist der rechte Vorsprung in eine Spitze ausgezogen"; pl. XXVIII, fig. 8 in this work of G. W. MÜLLER's represents a shell with such a spine; in the explanation of the figure this type is described as an „abweichende Form". According to this writer's exposition the left valve is never provided with a spine dorso-posteriorly in this species; in addition this species has no selvage: „Saum scheint überhaupt zu fehlen."

First antenna: While the specimens described by me above had somewhat more than twenty sensory bristles on the fourth joint, arranged in three almost parallel rows,

according to G. W. MÜLLER's original description this joint has a somewhat smaller number of these bristles (on p. 259 he says „gegen 20" and, according to pl. XXVIII, fig. 1, there are only fifteen), all arranged in one row. (It is to be noted that in this author's figures of the first antennae of both *E. Chierchiae* and *E. aculeata*, 1906 a, pl. XXXII, these sensory bristles are also placed in one row.)

Cf. also the remark under the genus on p. 739 above for the cavity on the second joint of this antenna.

Mandible: According to G. W. MÜLLER's statement of 1894, p. 49, the genus *Euconchoecia* is characterized by „eine fast vollständige Rückbildung des Zahnes" on the pars incisiva of the coxale. This statement clearly refers to *E. Chierchiae*. The figure of the pars incisiva of this joint given by this writer (1890 a, pl. XXVIII, fig. 10) is unfortunately too incomplete and uncertain to allow of a comparison of the development of the masticatory pad in this species. To judge from G. W. MÜLLER's original description, the development and the number of the bristles are different in *E. Chierchiae* and in the specimens investigated by me. I need only mention here that in G. W. MÜLLER's fig. 1, pl. XXVIII, the first endopodite joint has only one bristle on the posterior side and the end joint is armed with five bristles, of which the two longest are subequal and about as long as the total length of the two distal joints.

Maxilla: According to pl. XXVIII, fig. 6, G. W. MÜLLER, 1890 a, the end joint on this limb in *E. Chierchiae* either has five bristles, three of which are rather long and the two others very short and fine, or else it has only three bristles, in which case the short, fine „bristles" represent a couple of long, stiff hairs of the kind reproduced above for the form described by me. According to fig. 1 of the same plate, however, this joint has five well-developed bristles in *E. Chierchiae*. (No better illustration of the uncertainty in this writer's information could be desired.) Other differences in the numbers of the bristles can be found in these figures of *E. Chierchiae* given by G. W. MÜLLER and the specimens examined by me. For these I merely refer to a comparison between these figures and those given by me above.

A number of differences can be found in the following limbs as well.

It is natural that, under these circumstances, the identification was a matter of grave doubt; I even thought it best to add a query.

On the other hand I decided — though only after rather serious doubt — not to include *E. Chierchiae*, G. W. MÜLLER, 1906 a, in the above list of synonyms of the form described by me. This was due especially to the fact that in the above-mentioned work G. W. MÜLLER himself expressed a supposition that in this case he had been guilty of combining two very closely related forms; he writes as follows, p. 128: „Ich habe geglaubt, die verschiedenen Formen, welche sich durch die Ausbildung der Spitze der rechten Schale unterscheiden, als verschiedene Arten unterscheiden zu können, zumal mit der verschiedenen Gestaltung der Spitze Unterschiede in der Größe Hand in Hand gehen (diejenigen mit abgestutzter Spitze sind kleiner), doch habe ich in Ermangelung durchgreifender Unterschiede von der Aufstellung besonderer Arten abgesehen." It is, of course, impossible for me to decide whether this suspicion is justified or not, as I have not investigated this material, but it does not seem impossible that it is well grounded; this idea is supported, among other things, by the great variation in the length of the shell:

♀ = 1,15—1,53, ♂ = 1,15—1,45 mm. There is, in addition, the fact that this description of G. W. MÜLLER's is too incomplete to permit of a quite certain identification of the species and also that there are a number of differences between this description and the specimens investigated by me. This is shown by a comparison between G. W. MÜLLER's pl. XXXII, fig. 9, the shell of the female seen from the side, and my fig. 6.

For these reasons I also thought it best not to include in this list *E. Chierchiae*, G. W. MÜLLER, 1908, p. 80. No information at all is given in the latter work as to the lengths and types of the specimens that were caught.

The identification of *Paraconchoecia oblonga*, P. T. CLEVE, 1900, as determined by J. G. ANDERSSON, is based on a re-examination of the original specimens. (J. G. ANDERSSON does not seem to have been quite certain about the correctness of this identification of his, as he had added a query on the label; this was not included, however, by P. T. CLEVE.) Only two males were found in the two samples. Of these the specimen from lat. 33° 17′ N., long. 74° 2′ W. had a shell 1.17 mm. long, the specimen from lat. 42° 9′ N., long. 42° 15′ W. was 1,23 mm. long. The latter specimen was characterized by the fact that the two valves were furnished postero-dorsally with a moderately long spine; cf. fig. 3. Otherwise they agreed with the other specimens of this species investigated by me.

Under these circumstances it did not seem convenient to me to include *E. Chierchiae*, P. T. CLEVE, 1904, p. 370 in the list of synonyms given above; this form has no description or verificatory figures.

The inclusion of *E. Chierchiae*, G. S. BRADY, 1902 a as a synonym of the form described above is due not to any far-reaching resemblance between G. S. BRADY's description and figures and the specimens investigated by me, but to the fact that the description worked out by me above is based on the same material as formed the basis of this writer's description. (I cannot understand how V. VÁVRA was able to identify this species of G. S. BRADY's with *E. Chierchiae*, G. W. MÜLLER, 1890 a without a re-examination of the original material.) The following differences are noteworthy: Length of the shell in the female = 0,85 mm. The first antenna of the male has a very long bristle (about as long as the whole antenna) dorso-distally on the second joint; the female first antenna also has a bristle dorsally, but this is much shorter than that of the male. (Does this „bristle" correspond to the rod-shaped organ?) The end joint of the endopodite of the second antenna has only two bristles in the female. The mandible has a longitudinal row of hairs on the first and second endopodite joints (= the exopodite bristle?). The furca has only five claws. (This is a good illustration of the uncertainty in this writer's method of description!)

V. VÁVRA's form *E. Chierchiae*, 1906, p. 29, has not been included as a synonym, first because the description given by this writer is too uncertain to permit of certain species identification, and secondly because there are a number of differences between this description and the specimens examined by me.

P. T. CLEVE, in his work of 1905, p. 131, synonymizes *Halocypris aculeata*, TH. SCOTT, 1894, with *Euconchoecia Chierchiae*; no reasons are given for this. This synonymization was accepted by TH. SCOTT himself in two later works, 1909, p. 129 and 1912 a, p. 588; this author

did not give any reason for this procedure, either. Without attaching too great importance to these statements — the writers in question obviously did not possess any very profound knowledge of the systematic value of the different characters in this genus — I wish to point out that the length of the frontal organ in the above-mentioned species of TH. SCOTT's, especially in the female, (cf. loc. cit. pl. XV, fig. 33) agrees very much better with the corresponding organ in *E. Chierchiae*, re-described by me above, than with *E. aculeata*, G. W. MÜLLER, 1906 a. The shape of the shell, too, (see TH. SCOTT, 1894, pl. XV, figs. 5 and 6), seems to favour the view of the two first-mentioned writers more than that of G. W. MÜLLER. But on account of the incompleteness in the description given by TH. SCOTT it did not seem convenient to include the name *Halocypris aculeata* in the list of synonyms worked out above.

Habitat: — Atlantic Ocean:

S. A. E., Pl. station 23 b, lat. 19° 19′ S., long. 36° 9′ W.; at the surface; 3. XII. 1901; temperature, 25.2° C.: 2 mature males; R. M. S. 204. S. A. E., Pl. station 127, lat. 20° 35′ S., long. 37° 26′ W.; at the surface; 4. XII. 1901: 1 mature female; R. M. S. 205.

St. Johns (Lesser Antilles), Cruz Bay; 10. I. 1896; collector: CHR. LEVINSEN: 19 mature males, 18 mature females and 47 larvae (= the material examined by G. S. BRADY, 1902a). Stored in the collections of K. Z. M.

Lat. 33° 17′ N.,* long. 74° 2′ W.; 27. VII. 1898: 1 mature male ,, 42° 9′ ,, ,, 42° 15′ ,, 17. III. 1898: 1 ,, ,,	= the material of P. T. CLEVE's *Paraconchoecia oblonga*, 1900.

These two specimens are to be found in the collections of R. M. S., on slides. It is to be noted that these two stations are situated within the region of the Gulf Stream.

Distribution: — Coast of Brazil (G. W. MÜLLER, 1890 a).

List of the Tow Net Gatherings of the Swedish „Antarctic" Expedition 1901—03, with the Species of Halocyprids found in each.

Station 19. Lat. 36° 13′ N., long. 17° 16′ W.

At the surface. 4. XI. 1901. Temperature 18,5° C.

Conchoecia curta J. LUBBOCK	3 specimens.
,, *subarcuata* C. CLAUS	3 ,,
,, *spinirostris* ,, ,,	6 ,,

* Not 38° N., as is stated by P. T. CLEVE, 1900.

Station 23. Lat. 34° 2′ N., long. 18° 21′ W.

At the surface. 5. XI. 1901. Temperature 20,1° C.

Conchoecia oblonga (C. CLAUS) 4 specimens.
„ *echinulata* „ „ . 11 „
„ *subarcuata* C. CLAUS . . . . . 1 specimen.
spinirostris „ „ . . 1 „
species indet. juv. . . . . . . 5 specimens.

Station 26. Lat. 32° 21′ N., long. 19° 8′ W.

At the surface. 6. XI. 1901. Temperature, 20,5° C.

Conchoecia oblonga (C. CLAUS) . . . . 1 specimen.
„ *elegans* G. O. SARS . . . . 1 „
„ *curta* J. LUBBOCK . . . . 2 specimens.
„ *spinirostris* C. CLAUS . . . . 1 specimen.

Station 30. Lat. 29° 52′ N., long. 20° 14′ W.

At the surface. 7. XI. 1901. Temperature. 21,1° C.

Halocypris brevirostris (J. D. DANA) . . . . 1 specimen.
Conchoecia echinulata (C. CLAUS) . . . . 8 specimens.
„ *bispinosa* C. CLAUS . . . . 1 specimen.

Station 33. Lat. 28° 21′ N., long. 20° 42′ W.

At the surface. 8. XI. 1901. Temperature, 21,5° C.

Conchoecia spinirostris C. CLAUS . . . . 22 specimens.

Station 34. Lat. 27° 49′ N., long. 20° 51′ W.

At the surface. 8. XI. 1901. Temperature, 21,4° C.

Conchoecia elegans G. O. SARS . . . . 1 specimen.
„ *curta* J. LUBBOCK . . . . 22 specimens.
„ *echinulata* (C. CLAUS) . . . . 1 specimen.

Station 4 b. Lat. 25° 51′ N., long. 21° 29′ W.

At the surface. 9. XI. 1901. Temperature, 22,50° C.

Halocypris brevirostris (J. D. DANA) . . . . 10 specimens.
Conchoecia curta J. LUBBOCK . . . . 1 specimen.
„ *bispinosa* C. CLAUS . . . . 2 specimens.
„ *spinirostris* „ „ . . . . 2 „

Station 38. Lat. 25° 46′ N., long. 21° 31′ W.

At the surface; 9. XI. 1901. Temperature, 22,5° C.

Conchoecia echinulata (C. CLAUS) . . . . 1 specimen.

Station 6 b. Lat. 23° 35′ N., long. 22° 19′ W.

At the surface. 10. XI. 1901. Temperature, 23° C.

Halocypris brevirostris (J. D. DANA) . . . . 1 specimen.
Conchoecia oblonga (C. CLAUS) . . . . 1 „
„ *bispinosa* C. CLAUS . . . . 1 „

Station 7 b. Lat. 22° 26′ N., long. 22° 45′ W.

At the surface. 11. XI. 1901. Temperature, 23,6° C.

Halocypris brevirostris (J. D. DANA) . . . . 1 specimen.

Station 45. Lat. 22° 8′ N., long. 22° 52′ W.

At the surface. 11. XI. 1901. Temperature, 23,3° C.

Halocypris brevirostris (J. D. DANA) . . . . 1 specimen.
Conchoecia elegans G. O. SARS . . . . 1 „
„ *spinirostris* C. CLAUS . . . . 7 specimens.

Station 8 b (and 46). Lat. 21° 51′ N., long. 23° 0′ W.

At the surface. 11. XI. 1901. Temperature, 23,20° C.

Halocypris brevirostris (J. D. DANA) . . . . 8 specimens.
Conchoecia oblonga (C. CLAUS) . . . . 1 specimen.
„ *curta* J. LUBBOCK . . . . 2 specimens.
„ *bispinosa* C. CLAUS . . . . 1 specimen.

Station 53. Lat. 18° 10′ N., long. 24° 28′ W.

At the surface. 13. XI. 1901. Temperature, 23,8° C.

Halocypris brevirostris (J. D. DANA) . . . . 2 specimens.
Conchoecia spinirostris C. CLAUS . . . . 1 specimen.

Station 12 b. Lat. 14° 28′ N., long. 26° 1′ W.

At the surface. 15. XI. 1901. Temperature, 25,5° C.

Halocypris brevirostris (J. D. DANA) . . . . 32 specimens.

Station 14 b. Lat. 12° 21′ N., long. 26° 49′ W.

At the surface. 16. XI. 1901. Temperature, 26° C.

Halocypris brevirostris (J. D. DANA) . . . . 11 specimens.

Station 18 b (and 83). Lat. 1° 31′ N., long. 29° 7′ W.

At the surface. 22. XI. 1901. Temperature, 26,8° C.

Halocypris brevirostris (J. D. DANA) . . . . 2 specimens.
Conchoecia spinirostris C. CLAUS . . . . 1 specimen.

Station 95. Lat. 3° 7′ S., long. 30° 54′ W.

At the surface. 25. XI. 1901. Temperature, 26,3° C.

Conchoecia spinirostris C. CLAUS . . . . 2 specimens.

Station 20 b. Lat. 11° 9′ S., long. 32° 55′ W.
At the surface. 29. XI. 1901. Temperature, 26,4° C.
Conchoecia oblonga (C. CLAUS) . . . . . 5 specimens.
" *bispinosa* C. CLAUS . . . . . 5 "

Station 116. Lat. 15° 46′ S., long. 34° 8′ W.
At the surface. 1. XII. 1901. Temperature, 26,2° C.
Halocypris brevirostris (J. D. DANA) . . . . . 1 specimen.
Conchoecia curta J. LUBBOCK . . . . . 1 "

Station 23 b. Lat. 19° 19′ S., long. 36° 9′ W.
At the surface. 3. XII. 1901. Temperature, 25,2° C.
Halocypris brevirostris (J. D. DANA) . . . . . 3 specimens.
Conchoecia curta J. LUBBOCK . . . . . 39 "
" *echinulata* (C. CLAUS) . . . . . 2 "
Euconchoecia Chierchiae G. W. MÜLLER . . . . . 2 "

Station 127. Lat. 20° 35′ S., long. 37° 26′ W.
At the surface. 4. XII. 1901. Temperature unknown.
Conchoecia spinirostris C. CLAUS, ... 2 specimens.
Euconchoecia Chierchiae G. W. MÜLLER . . . . . 1 specimen.

Station 134. Lat. 24° 21′ S., long. 41° 23′ W.
At the surface. 6. XII. 1901. Temperature, 23,2° C.
Conchoecia elegans G. O. SARS . . . . . 4 specimens.
" *curta* J. LUBBOCK . . . . . 13 "
" *spinirostris* C. CLAUS . . . . . 1 specimen.

Station 28 b. Lat. 26° 58′ S., long. 44° 57′ W.
At the surface. 8. XII. 1901. Temperature, 22°,9 C.
Conchoecia curta J. LUBBOCK . . . . . 2 specimens.

Station 34 b. Lat. 46° 45′ S., long. 58° 2′ W.
Depth, 700—500 m. 28. XII. 1901. Temperature unknown.
Conchoecia elegans G. O. SARS . . . . . 8 specimens.
" *symmetrica* G. W. MÜLLER . . . . . 1 specimen.
" *hettacra* G. W. MÜLLER . . . . . 2 specimens.

Station 64 b. Lat. 48° 27′ S., long. 42° 36′ W.
Depth, 2500—0 m. 23. VI. 1902. Temperature at the surface, 7,9° C.
Conchoecia elegans G. O. SARS . . . . . 63 specimens.
" *Chuni* G. W. MÜLLER . . . . . 2 "
" *obtusata* G. O. SARS var. *antarctica* G. W. MÜLLER 96 "
" *rotundata* G. W. MÜLLER . . . . . 16 "

Conchoecia *Haddoni* G. S. Brady and A. M. Norman ...... 40 specimens.
.. *serrulata* C. Claus .... 345 ..
.. *lophura* G. W. Müller .... 1 specimen.
.. *parvidentata* G. W. Müller .... 6 specimens.
.. *hyalophyllum* C. Claus .... 1 specimen.
.. *borealis* G. O. Sars var. *antipoda* G. W. Müller 30 specimens.
.. *symmetrica* G. W. Müller .... 121 ..
.. *Valdiviae* ,, ,, ,, ... 2 ,,
.. species indet., juvenes .... 5 ,,

Station 65 b. Lat. 48° 27′ S., long. 42° 36′ W.
Depth, 400—0 m. 23. VI. 1902. Temperature at 400 m., 3,95° C.
Conchoecia obtusata G. O. Sars var. *antarctica* G. W. Müller 7 specimens.
.. *rotundata* G. W. Müller .... 1 specimen.
,, *serrulata* C. Claus .... 11 specimens.

Station 66 b. Lat. 48° 27′ S., long. 42° 36′ W.
Depth, 200—0 m. 23. VI. 1902. Temperature at 200 m., 5,25° C.
Conchoecia elegans G. O. Sars .... 4 specimens.
,, *obtusata* ,, ,, ,, var. *antarctica* G. W. Müller . 3 ,,
,, *rotundata* G. W. Müller .... 1 specimen.
,, *serrulata* C. Claus .... 15 specimens.

Station 67 b. Lat. 48° 27′ S., long. 42° 36′ W.
Depth, 100—0 m. 23. VI. 1902. Temperature at 100 m., 8,3° C.
Conchoecia serrulata C. Claus .... 27 specimens.

Station 68 b. Lat. 48° 27′ S., long. 42° 36′ W.
Depth, 50—0 m. 23. VI. 1902. Temperature at 50 m., 7,55° C.
Conchoecia serrulata C. Claus .... 5 specimens.

Station 345. Lat. 48° 32′ S., long. 44° 28′ W.
At the surface. 24. VI. 1902. Temperature, 7,9° C.
Conchoecia obtusata G. O. Sars var. *antarctica* G. W. Müller 1 specimen.
,, *serrulata* C. Claus .... 1 ,,

Station 347. Lat. 49° 3′ S., long. 46° 54′ W.
At the surface. 25. VI. 1902. Temperature, 4,5° C.
Conchoecia elegans G. O. Sars .... 1 specimen.
.. *obtusata* G. O. Sars var. *antarctica* G. W. Müller 2 specimens.
.. *serrulata* C. Claus .... 6 ..

Station 70 b. Lat. 49° 56′ S., long. 49° 56′ W.
Depth, 2700—0 m. 27. VI. 1902. Temperature at 2700 m. and at the surface, + 1,67° C. and 3,40° C. resp.

Conchoecia elegans G. O. SARS	21	specimens.
„ *Chuni* G. W. MÜLLER	1	specimen.
„ *obtusata* G. O. SARS var. *antarctica* G. W. MÜLLER	6	specimens.
„ *rotundata* G. W. MÜLLER	6	„
„ *Gaussi* G. W. MÜLLER	1	specimen.
„ *serrulata* C. CLAUS	2	specimens.
„ *borealis* G. O. SARS var. *antipoda* G. W. MÜLLER	9	„
„ *symmetrica* G. W. MÜLLER	18	„
„ *hettacra*	2	„

Station 70 b. Depth, 500—0 m.

Conchoecia elegans G. O. SARS	15	specimens.
„ *obtusata* G. O. SARS var. *antarctica* G. W. MÜLLER	2	„
„ *serrulata* C. CLAUS	5	„
„ species indet., a few juvenes.		

Station 357. Lat. 51° 31′ S., long. 54° 39′ W.

At the surface. 1. VII. 1902. Temperature, 5° C.

Conchoecia serrulata C. CLAUS .... 3 specimens.

Station 355. Lat. 51° 34′ S., long. 53° 18′ W.

At the surface. 30. VI. 1902. Temperature, 4,5° C.

Conchoecia serrulata C. CLAUS .... 8 specimens.

Station 302. Lat. 52° 6′ S., long. 55° 32′ W.

Depth, 500—0 m. 12. IV. 1902. Temperature at 500 m. and at the surface, 3,78° C. and 6,28° C. resp.

Conchoecia obtusata G. O. SARS var. *antarctica* G. W. MÜLLER	2	specimens.
„ *serrulata* C. CLAUS	11	„

Station 301. Lat. 52° 6′ S., long. 55° 32′ W.

Depth, 100—0 m. 12. IV. 1902. Temperature at 100 m., 5,78° C.

Conchoecia serrulata C. CLAUS .... 31 specimens.

Station 300. Lat. 52° 6′ S., long. 55° 32′ W.

Depth, 50—0 m. 12. IV. 1902. Temperature at 50 m., 6,21° C.

Conchoecia serrulata C. CLAUS .... 12 specimens.

Station 298. Lat. 52° 6′ S., long. 55° 32′ W.

At the surface. 12. IV. 1902. Temperature, 6,3° C.

Conchoecia serrulata C. CLAUS .... 15 specimens.

Station 60 b. Lat. 52° 39′ S., long. 37° 35′ W.

Depth, 500—0 m. 17. VI. 1902. Temperature at 500 m. and at the surface, + 1,35° C. and ÷ 0,50° C. resp.

Conchoecia serrulata C. CLAUS . . . . 1 specimen.
,, *hettacra* G. W. MÜLLER . . . . 6 specimens.

Station 61 b. Lat. 52° 39′ S., long. 37° 35′ W.

Depth, 2000—0 m. 17. VI. 1902. Temperature at 2000 m., ÷ 1,30° C.

Conchoecia hettacra G. W. MÜLLER . . . . 1 specimen.

Station 307. Lat. 52° 55′ S., long. 53° 12′ W.

At the surface. 14. IV. 1902. Temperature, 6,1° C.

Conchoecia serrulata C. CLAUS . . . . 6 specimens.

Station 59 b (and 318). Lat. 53° 0′ S., long. 48° 27′ W.

Depth, 500—0 m. 17. IV. 1902. Temperature at 500 m. and at the surface, + 1,50° C. and 3,40° C. resp.

Conchoecia elegans G. O. SARS . . . . 9 specimens.
,, *isocheira* G. W. MÜLLER . . . . 1 specimen.
,, *serrulata* C. CLAUS . . . . 74 specimens.
,, *hettacra* G. W. MÜLLER . . . . 15 ,,

Station 58 b (and 317). Lat. 53° 0′ S., long. 48° 27′ W.

Depth, 250—0 m. 17. IV. 1902. Temperature at 250 m., + 1,30° C.

Conchoecia elegans G. O. SARS . . . . 1 specimen.
,, *Chuni* G. W. MÜLLER . . . . 5 specimens.
,, *obtusata* G. O. SARS var. *antarctica* G. W. MÜLLER 1 specimen.
,, *isocheira* G. W. MÜLLER . . . . 1 ,,
,, *serrulata* C. CLAUS . . . . 273 specimens.
,, *hettacra* G. W. MÜLLER . . . . 15 ,,

Station 57 b (and 316). Lat. 53° 0′ S., long. 48° 27′ W.

Depth, 100—0 m. 17. IV. 1902. Temperature at 100 m., 3° C.

Conchoecia obtusata G. O. SARS var. *antarctica* G. W. MÜLLER 1 specimen.
,, *serrulata* C. CLAUS . . . . 132 specimens.
,, *hettacra* G. W. MÜLLER . . . . 1 specimen.

Station 56 b (and 315). Lat. 53° 0′ S., long. 48° 27′ W.

Depth, 50—0 m. 17. IV. 1902. Temperature at 50 m., 3,35° C.

Conchoecia serrulata C. CLAUS . . . . 190 specimens.

Station 314. Lat. 53° 0′ S., long. 48° 27′ W.

At the surface. 17. IV. 1902. Temperature, 3,38° C.

Conchoecia serrulata C. CLAUS . . . . 246 specimens.

Station 312. Lat. 53° 1′ S., long. 51° 53′ W.

Depth, 200—0 m. 15. IV. 1902. Temperature at 200 m. and at the surface, 3,50° C. and 5,48° C. resp.

Conchoecia Chuni G. W. MÜLLER . . . . 1 specimen.

,, *obtusata* G. O. SARS var. *antarctica* G. W. MÜLLER . . . 6 specimens.

,, *serrulata* C. CLAUS . . . . 8 ,,

Station 311. Lat. 53° 1′ S., long. 51° 53′ W.

Depth, 70—0 m. 15. IV. 1902. Temperature at 70 m. 5,25° C.

Conchoecia serrulata C. CLAUS . . . . 4 specimens.

Station 319. Lat. 53° 13′ S., long. 47° 0′ W.

At the surface. 18. IV. 1902. Temperature, 3,31° C.

Conchoecia serrulata C. CLAUS . . . . 2 specimens.

Station 291. Lat. 53° 15′ S., long. 60° 53′ W.

At the surface. 25. III. 1902. Temperature, 7,3° C.

Conchoecia serrulata C. CLAUS . . . . 4 specimens.

Station 320. Lat. 53° 29′ S., long. 45° 23′ W.

At the surface. 18. IV. 1902. Temperature, 3,67° C.

Conchoecia serrulata C. CLAUS . . . . 2 specimens.

Station 279. Lat. 55° 15′ S., long. 65° 17′ W.

At the surface. 3. III. 1902. Temperature, 8,6° C.

Conchoecia serrulata C. CLAUS . . . . 7 specimens.

Station 214. Lat. 57° 9′ S., long. 60° 28′ W.

At the surface. 7. I. 1902. Temperature, 6° C.

Conchoecia serrulata C. CLAUS . . . . 3 specimens.

Station 42 b. Lat. 65° 49′ S., long. 58° 40′ W.

Depth, 250—0 m. 18. I. 1902. Temperature at 250 m. and at the surface, — 1,35° C. and + 1,10° C. resp.

Conchoecia Belgicae G. W. MÜLLER . . . . 5 specimens.

Station 44 b. Lat. 65° 56′ S., long. 54° 35′ W.

Depth, 700—0 m. 22. I. 1902. Temperature at the surface, — 1,15° C.

Conchoecia isocheira G. W. MÜLLER . . . . 8 specimens.

,, *hettacra* ,, ,, ,, ... 1 specimen.

Sub-Order III. Polycopiformes.

Sectio *Cladocopa*, G. O. Sars, 1865, p. 121.
Fam. *Polycopidae*, G. W. Müller, 1894, p. 231.
Sectio *Cladocopa*, G. S. Brady and A. M. Norman, 1896, p. 705.
Fam. *Polycopidae*, G. W. Müller, 1912, p. 97.

Diagnosis: — See G. O. Sars loc. cit. and G. W. Müller, 1894, p. 231.

Historical: — See G. W. Müller, 1894, p. 232.

Family Polycopidae.

Family *Polycopidae*, G. O. Sars 1865, p. 121; G. W. Müller 1894, p. 231, 1912, p. 97; G. S. Brady and A. M. Norman 1896, p. 705.

Diagnosis: — See sub-ordo *Polycopiformes*.

Genus Polycope G. O. Sars.

For synonymy see G. W. Müller, 1894, p. 233.

Diagnosis: — See G. W. Müller loc. cit.

Remarks: — As I had only a single species of this genus at my disposal and as most of the other species are described in an incomplete and uncertain manner, it did not seem to me convenient to work out a detailed description such as is given in the case of other genera. For the same reason I have not worked out a description of this family.

Polycope setigera n. sp.

Description: Shell: Length: 0.70 mm. Seen from the side it is almost circular (see the appended fig. 1) and has an extremely small ventrally pointing spine at about the middle of the anterior side. Seen from below it is lentil-shaped, about the same as in pl. 8, fig. 29, G. W. MÜLLER, 1894. The surface of the shell has small foveolae situated close together and has a scarcely perceptible reticulation.

First antenna (see the appended fig. 2): — This has four joints; the first and the second joints are rather closely joined to each other, the former, as G. W. MÜLLER pointed out, 1894, p. 233, being situated laterally of the latter. The proportion between the joints is about as follows:

$$\mathrm{I} : \mathrm{II} : \mathrm{III} : \mathrm{IV} = \frac{6}{25} : \frac{10}{20} : \frac{7}{[illegible]} : \frac{2}{2}.$$

The first joint has no bristles. At the middle of the dorsal side of the second joint there is a short-haired or almost bare bristle, which is about half as long as the dorsal side of this joint. The third joint has dorsally a plumous bristle, which is somewhat longer than this joint. The end joint has five narrow natatory bristles, the four longest of which are about twice as long as this limb, the remaining one about a third shorter; they are all furnished proximally with rather short natatory hairs and are bare distally. The wall of the second joint grows very much thicker dorsally, distally of the bristle. Pilosity: The first joint has some oblique longitudinal rows of short, fine hairs on the inside. Second joint: Proximally of the bristle this joint is furnished dorsally with a dense mass of rather long hairs and has moderately long hairs scattered medially. Distally of the bristle this joint is furnished with short, stiff hairs, placed close together dorsally; similar hairs are also found along the distal edge of this joint. There is a collection of rather long hairs ventrally on this joint just in front of the point where the bristle is fixed. The third joint has short, fine hairs ventrally.

Second antenna: Protopodite: This is about a quarter of the length of the shell and is of the type reproduced by G. W. MÜLLER, 1894, pl. 7, fig. 5; it has no bristles or appendages. Exopodite (see the appended fig. 3): This is somewhat more than half the length of the protopodite and is of about the same type as in the figure of G. W. MÜLLER's just mentioned. It has nine joints; the first joint is not quite so long as the total length of the eight following joints. Unlike in the Cypridinids and Halocyprids, there is a long natatory bristle ventero-medially on each of the first eight joints (the branch in thought of as pointing forward as in fig. 6, pl. 7, G. W. MÜLLER, 1894); these bristles are furnished with more or less long natatory hairs along the greater part of their length (they have no spines, unlike in a number of Cypridinids); the distal part of these bristles is not widened or specifically differentiated in any other way. The bristles on the first to the eighth joints are subequal, about as long as or even somewhat more than twice the length of the protopodite. The end joint has three bristles. The ventral one of these three is about two and a half times the length of the exopodite; one of the two others is about as long as this branch, the other is about as long as the total length of the 3—5 distal joints. The shortest of these three bristles is almost bare, the two others are furnished with rather short natatory hairs. At the middle of the inside there

is a spine on the distal edge of the first to the seventh joints; on the first joint this spine is moderately large, on the following ones it decreases gradually in strength the more distally it is situated. All the joints are bare. E n d o p o d i t e (see the appended fig. 4): This is somewhat more than half the length of the exopodite; it has three joints, all of which are distinctly developed. The first joint is from three to four times as long as the second joint, which is some-

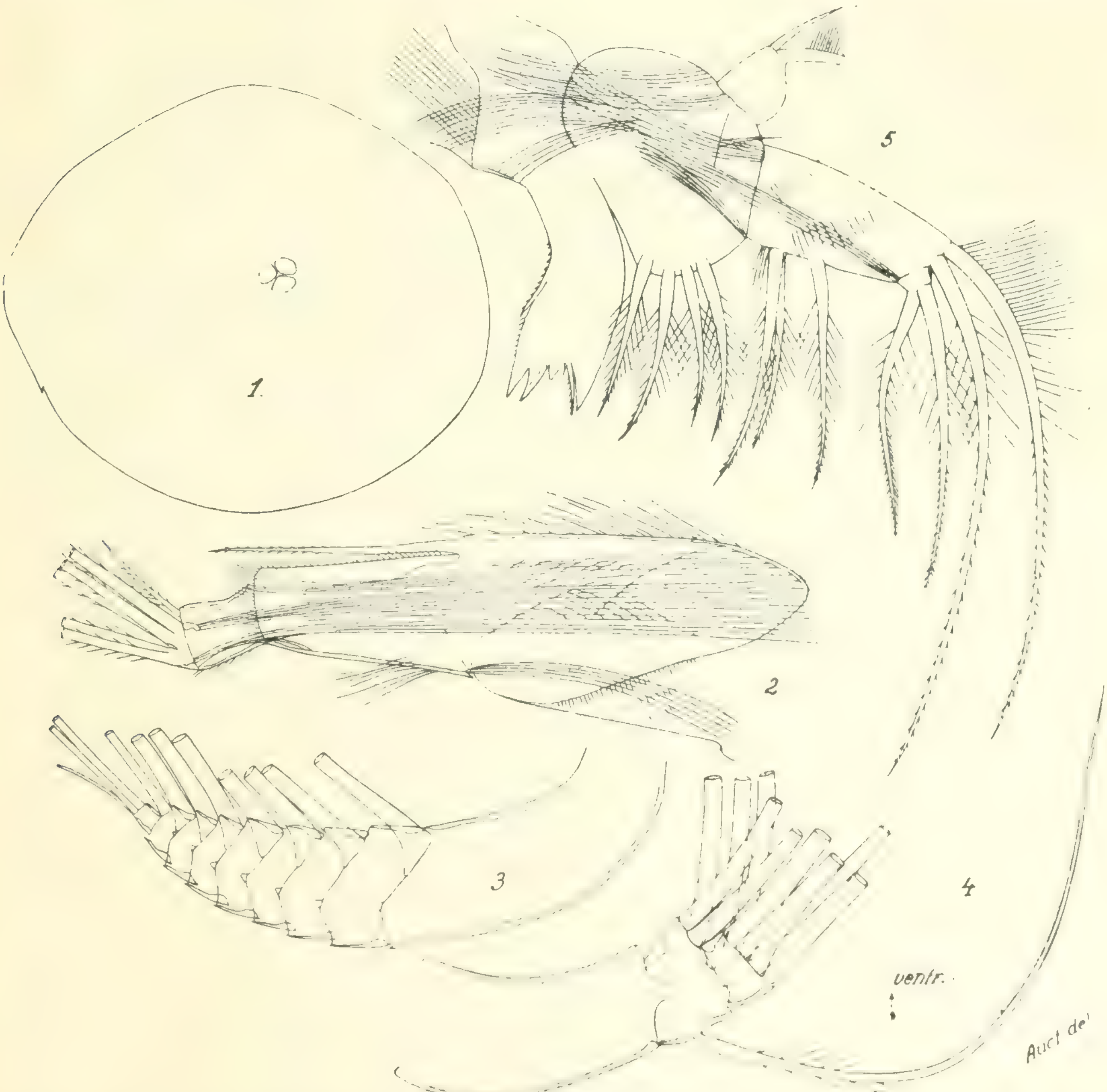

Fig. CLII. — *Polycope setigera* n. sp., ♀. 1. Left valve seen from the side; 105 ×. 2. Right first antenna seen from inside; the long end bristles are broken; 464 ×. 3. Exopodite of the left second antenna seen from inside; the long bristles are broken, those of the 1st—8th joints are drawn as if they were transparent; 848 ×. 4. Endopodite of the left second antenna seen from outside; the long bristles are broken; 848 ×. 5. Mandible; 408 ×.

what longer than the end joint. The first joint has no bristles. The second joint has at the middle a single bristle, which is somewhat longer than this branch; this bristle has some rather long hairs proximally of the middle, but apart from these it is almost or quite bare. Distally on this joint there are five natatory bristles, which are of about the same length and type as the long natatory bristles on the exopodite. The end joint has four bristles distally, three of which are of about the same length and type as those on the preceding joint, the fourth somewhat shorter. All the joints are bare.

Mandible (see the appended fig. 5): — This is of about the same type as in *Polycope frequens* G. W. MÜLLER; see this author, 1894, pl. 7, fig. 7. Protopodite: This has three rather distinct joints. The procoxale has no bristle or endite. The coxale is developed ventrally as a long, powerful endite which is furnished distally with three powerful pointed teeth, with a smaller tooth of the same kind between the two anterior ones, and two short-haired bristles, one of which is about as long as the large teeth, the other exceedingly short. At the middle of the posterior side of this endite there is, in addition, a rather short bristle with short hairs. Basale: This is somewhat swollen ventrally and is there furnished with four subequal bristles, which are plumous at the middle and have short hairs distally; these bristles are about as long as the height of this joint. Somewhat in front of and dorsally of the middle this joint has on one side a rather short plumous bristle as well. Exopodite: There are indications of a division into two joints. The proximal joint has a single bare bristle dorso-distally, which is about as long as this joint. The distal joint is narrow and cylindrical and has no bristles. Endopodite: This has two joints. The first joint has ventrally at and somewhat proximally of the middle three subequal bristles of about the same type as the ventral bristles on the basale and about as long as or rather slightly longer than these. Dorso-distally on this joint there are two subequal bristles of about the same length as the whole of this limb; these bristles are furnished proximally with rather long hairs (these hairs are numerous, especially on the anterior side of the anterior one of these two bristles) and have short hairs distally. The end joint is extremely small and is furnished with two subequal bristles of about the same type and length as the ventral bristles on the first endopodite joint. Pilosity: On the posterior side and distally on the endite of the coxale there are short, stiff hairs, situated rather close together. Dorsally on the distal joint of the exopodite there is a collection of rather long, fine hairs. The first endopodite joint is also furnished with hairs, some on the side and some ventrally-proximally.

Maxilla (see the appended fig. 6): — This is of about the same type as in *Polycope frequens* G. W. MÜLLER; see this writer, 1894, pl. 7, fig. 14. Protopodite: This is distinctly three-jointed; all the joints are strong and of about the same length. Procoxale: Ventrally-medially-distally this has a rather weak endite, armed with five bristles of somewhat different lengths, the longest one being somewhat shorter than the height of this joint, the shortest about a third of this length; they are all furnished with fine and rather long secondary bristles, situated close together. Ventero-distally on this joint there are also three bristles of about the same type and length as the longest ones on the above-mentioned endite. Apart from these this joint has no bristles. Coxale: This has two very weak endites ventero-medially. On the proximal endite there are four long-haired bristles; the two proximal ones of these bristles

are somewhat longer than the height of this joint, the two others are only about half as long. On the distal endite there are only two bristles of about the same type and length as the two distal bristles on the preceding endite. In addition there are on this joint, ventrally of the distal endite, two long-haired subequal bristles, which are about as long as the total length of the coxale and the basale. Basale: This has only two bristles, both with long hairs and situated ventrally-distally; one is about as long as or somewhat longer than the two bristles just mentioned, the other is about a third or a half of this length. E x o p o d i t e: About as long as the coxale, rather narrow and unjointed. It has nine bristles distally, of different lengths, the longest one being about as long as this limb, the shortest about half as long. A number of these bristles have rather sparse moderately long secondary bristles, others are more or less completely bare. E n d o p o d i t e: This has three joints; the first joint is about as long as the basale, the second joint is about half as long, the end joint is very small. The first joint has at about the middle of the ventral side a long-haired bristle which is about as long as the total length of the basale and this joint. Second joint: This has two bristles dorso-distally, which have long hairs at the middle. One of these bristles is about as long as the basale and the endopodite together, the other is about a quarter of this length. Ventero-distally this joint has three long-haired bristles of different lengths; the longest one is almost as long as this limb, the shortest one is only about half this length. The end joint has four bristles; two of these are about as long as the total length of the basale and the endopodite, the two others are somewhat longer; these four bristles are furnished with a few long secondary bristles at the middle but are otherwise bare. Pilosity: The basale is somewhat hairy ventrally. The exopodite has two transverse rows of rather long hairs dorsally. The first endopodite joint has three similar rows dorsally.

F i f t h l i m b (see the accompanying fig. 7): — This is of about the same type as in *Polycope frequens* G. W. MÜLLER; see this author, 1894, pl. 7, fig. 15. The protopodite is very large and foliaceous; it consists of two joints, the proximal one of which, (the procoxale +) the coxale, is about square and is somewhat larger than the triangular basale. The coxale has no endites. Somewhat distally of the middle it has two short bristles with long hairs. Distally-medially there are two short bristles, one of which has short hairs, the other being bare. Apart from these this joint has no bristles. Basale: Just proximally of the exopodite there are on the outside edge three long-haired bristles, one of which is about as long as this joint, the two others somewhat shorter. On the inner edge of this joint there are four bristles, three in a group somewhat distally of the middle and one distally. The distal one of these and one of the three others have long hairs and are about as long as the two shorter ones on the outer edge of this joint, the other two are short, one bare, the other plumous. The e p i p o d i a l a p p e n d a g e, which is attached along the whole coxale, is furnished with eleven or twelve marginal bristles, all of which have long hairs, placed close together in the shape of a feather. The e x o p o d i t e is somewhat displaced proximally, rather small, unjointed, and has five distal long-haired bristles of different lengths; the shortest one is almost as long as the basale, the longest one is about twice as long as the shortest one. The e n d o p o d i t e is somewhat smaller than the exopodite and has signs of two joints. It has only one bristle, which is situated distally and is of about the same length and type as the shortest bristle on the exopodite. Pilosity: On the

Fig. CLIII. — *Polycope setigera* n. sp., [illegible]. — 6. Right maxilla seen from inside; 312 ×. 7. Fifth limb; most of the bristles of the epipodial appendage are broken; 408 ×. 8. Furca; 408 ×. 9. Upper lip and the naked joints of the first antenna; 192 ×.

inner edge of the coxale there are three groups of stiff hairs. Distally on this joint there is, in addition, an oblique transverse row of fine hairs. On the inner edge of the basale there are stiff hairs, situated close together. Apart from these there are rather numerous hairs scattered on this joint. The exopodite is bare, the endopodite is hairy.

F u r c a (see the appended fig. 8): — This is almost exactly of the same type as in the species just mentioned; see G. W. MÜLLER, 1894, pl. 7, fig. 24. It has consequently seven moderately long and strong claws, which decrease uniformly in size the more posteriorly they are situated and are all well marked off from each other. The pectination of the claws is uniform. Between all the claws there is a triangular process, the one between claws no. 1 and 2 being rather large, the others decreasing in size and strength posteriorly; the posterior one is quite small. There is also a little spine behind the posterior claw. The larger ones of these processes are furnished distally with a collection of fine hairs. In front of claw no. 1 there is a triangular pointed process, about as large as or somewhat larger than the process between claws nos. 1 and 2. On this spine there is a series of rather strong small spines, which continue some distance up on the lateral side of the lamella. On the inner side the lamella is partly furnished with short hairs. Just behind the claws there is an unpaired process (the end of the body) with a single bare bristle, somewhat shorter than the posterior furcal claw.

Dorsally of the furca there are on the back some transverse folds furnished with a series of fine, stiff hairs.

On the front at the same place as the rod-shaped organ in *Cypridiniformes* and *Halocypriformes* there is a low swelling, furnished with two long-haired subequal bristles about as long as the dorsal side of the second joint of the first antenna; see the appended fig. 9 (a character from which this species is named).

The u p p e r l i p is rather helmet-shaped (fig. 9) and has some groups of fine, stiff hairs.

Relation to other forms.

Remarks: — On account of the incompleteness and uncertainty of the descriptions of most species belonging to this genus it is exceedingly difficult to decide with certainty the systematic position of the form described above. It is certainly very closely related to the species *P. frequens* G. W. MÜLLER which has been mentioned on several occasions above.

The bristles on forehead.

The most curious thing about this species of mine seems to be the two bristles on the front at the place where the rod-shaped organ is found in C y p r i d i n i d s and H a l o c y p r i d s. As there are a couple of bristles at about the corresponding place in both *Copepoda* and *Cladocera* it seems to me not improbable that we are concerned here with a very old character; cf. p. 96 above and C. CLAUS, 1891 a, p. 18.

Habitat: — Monaco, just off the harbour; depth 200 m.; fine clay; 27. III. 1916: 1 mature female; R. M. S., on slides (auctor coll.).

Abbreviations.

Expeditions:

- S. A. E. = Swedish „Antarctic" Expedition. 1901—03.
- S. G. E. = Swedish Greenland Expedition.
- S. M. E. = Swedish Magellan (Tierra del Fuego) Expedition.
- S. S. E. = Swedish Spitzbergen Expedition.

Museums:

- B. Z. M. = Bergens Zoolog. Museum.
- Chr. Z. M. = Christiania Zoolog. Museum.
- K. Z. M. = Kjøbenhavns Zoolog. Museum.
- R. M. S. = Riksmuseum Stockholm (Swedish State Museum).
- U. M. = Uppsala Zoolog. Museum.

Shell:

- e. = edge.
- i. l. = inner line.
- j. l. = joining line.
- l. = list.
- s. = selvage.
- s. s. = secondary selvage.

Limbs:

- Ba. = basale.
- Co. = coxale.
- E. = endite.
- Ep. = epipodial appendage.
- Pc. or Pco. = procoxale.
- Pr. = protopodite.
- Re. = exopodite.
- Ri. = endopodite.

Other abbreviations:

- ant. = anterior.
- ch. l. = chitinous list.
- dist. = distal.
- dors. = dorsal.
- ext. = exterior.
- int. = interior.
- m. = muscle.
- post. = posterior.
- ventr. = ventral.

Index.

Bibliography.

For the abbreviations of the titles of the periodicals see the „Zoological Record".
Cd. = *Cypridiniformes;* H. = *Halocypriformes;* P. = *Polycopiformes;* C. = *Cypriformes;* Ct. = *Cytherelliformes*;
m. = marine; f. = freshwater. × Nothing about the Ostracods.

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Contents.

Corrigenda.

P. 1[illegible]7: 23. „importance the abundance, of nourishment“ — „importance of the abundance of nourishment.“

P. 151: [illegible]0. *Mon[illegible]us lenticularis* is probably not an Ostracod but identical with the Phyllopod-species *Limnadia lenticularis* (L.).

P. 225: 13. „C. (Doloria) levis n. p.“ — „C. (Doloria) levis n. sp.“

P. 300: 32. „Siphonostra spinifera n. sp.“ — „C. (Siphonostra) spinifera n. sp.“

P. 317: 35. „Cypridina serrata (G. W. Müller) var. affirmans n. var.“ — „C. (Cypridina) serrata (G. W. Müller) var. affirmans n. var.“

P. [illegible]: 31. „about $^1/_3$ times“ — „about $1^1/_3$ times.“

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